SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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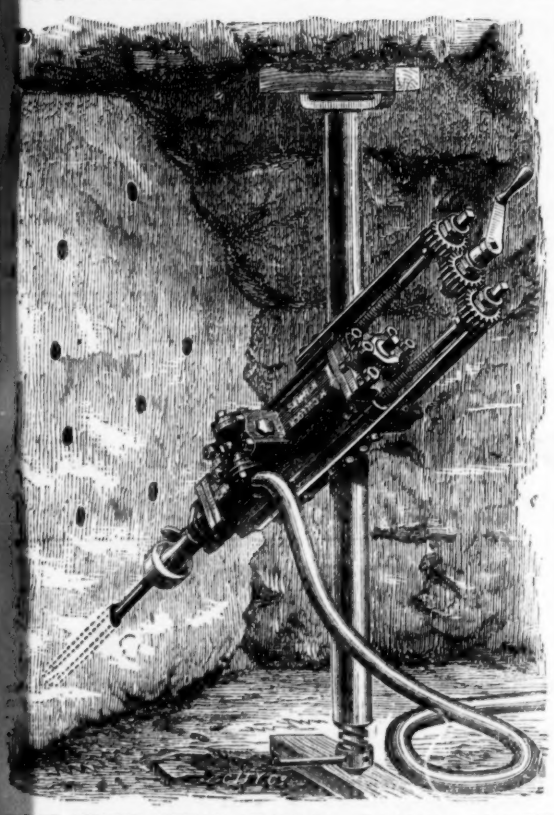
No. 2578.—VOL. LV. LONDON, SATURDAY, JANUARY 17, 1885. PRICE (WITH THE JOURNAL) SIXPENCE BY POST £1 4s. PER ANNUM.

FIRST SILVER MEDAL, ROYAL CORNWALL POLYTECHNIC —Highest Award for Effectiveness in Boring, and Economy in the Consumption of Air.

JUBILEE EXHIBITION, 1882.

THE PATENT

"CORNISH" ROCK DRILL.



FIRST SILVER MEDAL AWARDED AT BORING COMPETITION, DOLCOATH MINE, 1881.

The "CORNISH" ROCK DRILL and "CORNISH" COMPRESSOR

Are now largely in use, and in every case are giving entire satisfaction.

For Testimonials, Illustrated Catalogues and prices, apply to—

HOLMAN BROTHERS,

CAMBORNE FOUNDRY,

MAKERS OF

MICHELL & TREGONING'S PATENT PULVERISER, and HOLMAN'S IMPROVED STEAM or AIR PUMPING and WINDING ENGINE for Underground Quarries or Shallow Mining. Indispensable for Shaft Sinking with Rock Drills. Also makers of all kinds of MINING MACHINERY at

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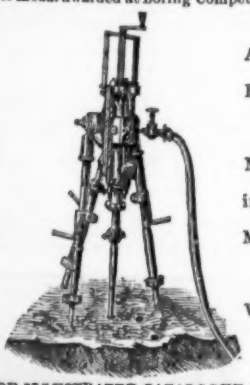
THE PATENT

"ECLIPSE" ROCK-DRILL AND "RELIANCE AIR-COMPRESSOR."

First Silver Medal awarded at Boring Competition, East Pool Mine, Sept. 1883.

SILVER MEDAL.—PARIS, 1878.—HIGHEST AWARD



Are NOW SUPPLIED to the ENGLISH, FOREIGN, and COLONIAL GOVERNMENTS, and are also IN USE in a number of the largest MINES, RAILWAYS, QUARRIES, and HARBOUR WORKS in GREAT BRITAIN and ABROAD.

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All kinds of WROUGHT and CAST IRON STRUCTURAL WORK, including Girders, Tanks, Boilers, Colliery Plant, Winding Engines, Iron Coal Wagons, heavy Smith Forgings, Dock Gates and Caisons, and requirements of Harbour and Dock Works, &c., &c.

All Orders executed promptly, and Tenders from Plans and Specifications.

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"INGERSOLL ROCK DRILL."

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SEVEN YEARS IN SUCCESSION,

FOUR IN ONE YEAR.

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AWARDED FOR

SIMPLICITY in CONSTRUCTION.
AUTOMATIC FEED
(Perfect success)
GREAT STEADINESS.
GREAT POWER.
GREAT DURABILITY.
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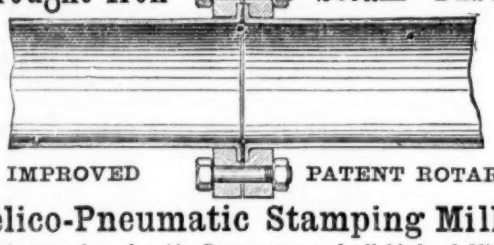
Wrought-Iron Steam Tubes.



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The New System for Working Gold, Stream Tin, and Diamond Alluvials.

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9, BUSH LANE, CANNON STREET, LONDON, E.C.

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A small Syndicate is being formed to work a Ball Gold Dredging and Saving Plant on an extraordinary property on the following terms:—The Syndicators find the machinery and the capital to work it—about £2000 at most. They receive back out of gold raised—1. All their expenses.—2. One-sixth of the gold remaining after this deduction.

The concession is rich, inexhaustible, runs for about 50 years, and covers an enormous mileage of a river, in a most healthy climate, within one month from London, with good roads, cheap living, civilised country, and in fact every circumstance conducive to a great success.

CAPITAL HALF SUBSCRIBED.

MACHINERY IN HAND TO LEAVE WITH STAFF IN JANUARY.

FEW SHARES LEFT.

See *Mining Journal*, Nov. 15, 1884, "On Prosperous Gold Mining Enterprise," and Nov. 29, 1884, "Ball Gold Syndicate—No. 3," page 1397.

AIR COMPRESSORS,

With R. SCHRAM'S Patent Inlet and Outlet Valves.

BOILERS, TURBINES.

SCHRAM'S IMPROVED

ROCK DRILL.

1600 in Use in all Parts of the World.

Complete Rock Boring Plants of the most approved construction for Railway Tunnels, Quarries, Shaft Sinking, Level Driving, Stoping, and Submarine Blasting.

All Kinds of Mining Machinery.

ESTIMATES AND FULL PARTICULARS ON APPLICATION.

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GILBERT GILKES & CO.,

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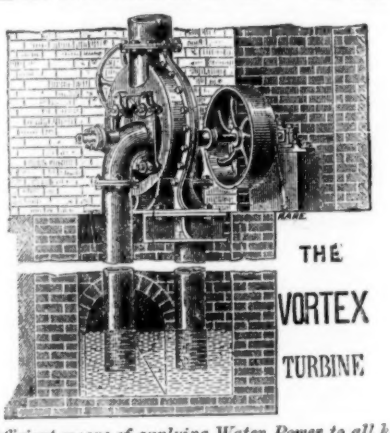

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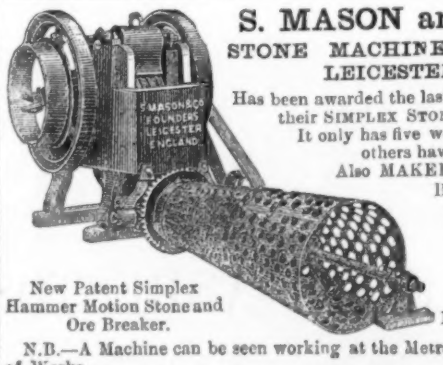
A most efficient means of applying Water Power to all kinds of Machinery.

Largely used in DRIVING AIR COMPRESSORS, PUMPING, WORKING ORE-CRUSHING MACHINERY, and for other purposes in connection with MINING.

Successfully used in ELECTRIC LIGHTING, and in utilising DISTANT WATER POWER by means of ELECTRICITY.

A Pamphlet containing a full description of the Vortex, with several Illustrations and a number of Testimonials, can be obtained on application.



New Patent Simplex Hammer Motion Stone and Ore Breaker.

S. MASON and Co.,

STONE MACHINE WORKS, LEICESTER,

Has been awarded the last MEDAL for their SIMPLEX STONE BREAKER. It only has five wearing parts; others have 26.

Also MAKERS of the BLAKE MACHINES, with all the Latest Improvements.

N.B.—A Machine can be seen working at the Metropolitan Board of Works.

SECOND YEAR OF PUBLICATION.

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(ANGLO-RUSSIAN JOURNAL OF TRADE.)

Is devoted to the promotion and development of English Export Trade with Russia. By its vast information and superior engravings the Anglo-Russki Torgovy Journal has taken, immediately after its appearance, the first rank among all the commercial and engineering papers published in Russia. This is undoubtedly proved by the large circulation it has acquired all over Russia, from the Baltic to the Pacific, and from the White Sea to the Black Sea; by numerous testimonials and expressions of satisfaction and encouragement continually arriving from the remotest corners of the Russian Empire; by the unanimous avowal of the Russian periodical press; and the fact of the native Russian engineering contemporaries making extensive use of the Anglo-Russki Torgovy Journal by frequently reproducing its articles and paragraphs. It is, therefore, self-evident that no better medium can be found by English Manufacturers and Exporters for reaching Russian Importers of foreign goods and all kinds of machinery, for which Russia, though abounding in natural riches, is mainly dependent on Western countries. England's Export Trade with Russia is still very far from having assumed its natural or due proportions, and the Anglo-Russki Torgovy Journal offers the fittest means of finding out its proper markets and channels. It is consequently in the interest of English advertisers to avail themselves without delay of the exceptional advantages and facilities opened to them for the first time by the Anglo-Russki Torgovy Journal.

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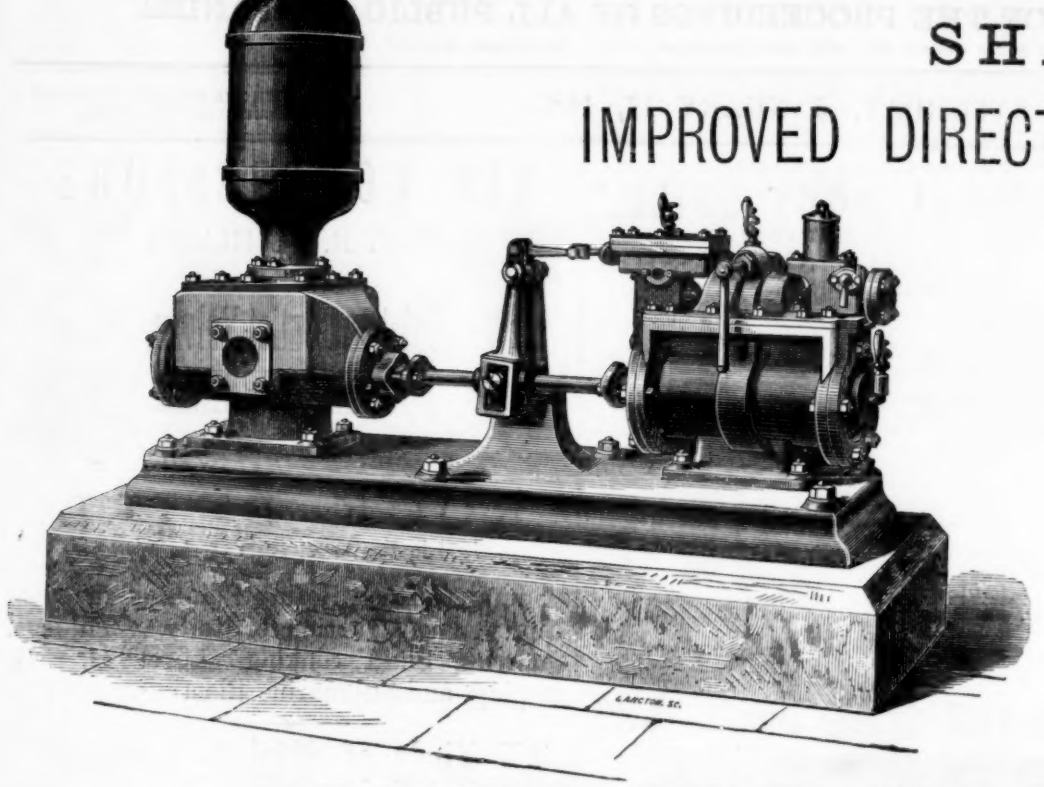
OFFICES IN RUSSIA: 14, NEVSKI PROSPECT, ST. PETERSBURG.



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IMPROVED DIRECT-ACTING STEAM PUMP.

FOR

MINING, DRAINING, IRRIGATING, AND PUMPING PURPOSES GENERALLY.

These Pumps possess advantages over all Direct-Acting Pumps. The utmost regularity in reversing, and steadiness in working is so thoroughly secured that a piston speed of 8 ft. per minute has been obtained.

COMPOUND STEAM PUMPS, AND ALL KINDS OF PUMPING AND HOISTING MACHINERY ESTIMATED FOR.

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BELL'S ASBESTOS.

BELL'S PATENT ASBESTOS BLOCK PACKING for High Pressure Engines

The followi g testimonials refer to this Packing:—

Mona Lodge, Amlwich, Anglesey,
2nd August, 1884.

DEAR SIR,—I have much pleasure in answering your note. Bad times in mining have compelled me to try all kinds of expedients in order to effect saving; some have succeeded and some have failed, but my underground manager, Capt. Hughes, has just said to me by the telephone—"The Asbestos Packing is the best thing ever brought here."

It saves money and trouble, but like my gas purifying oxide it lasts so long that you must not expect another order from me for twelve months at least.

Yours truly, T. F. EVANS,
Late H.M. Inspector of Metalliferous Mines.

Mr. J. Bell.

Manchester, Sheffield, and Lincolnshire Railway—Steamship Department,
Grimsby, April 10th, 1884.

DEAR SIR,—I have much pleasure in stating that after a trial of over nine months, and comparing it with other packings, I can confidently recommend your Asbestos Packing. It is especially valuable when high-pressures are employed, as in cases where other packings have perished, owing to high temperatures, your packing has invariably stood well. I have also used it with complete success when a gland has heated with other packings, and also in cases of badly scored piston rods. I consider the results I have obtained by its use for our marine engines to have been in every way highly satisfactory. Yours truly,
G. H. CLARKE, Sup. Engineer.

Mr. J. Bell.

Department of the Director of Navy Contracts,
Admiralty, Whitehall, 20th June, 1884.

SIR,—I have to inform you that your tender has been accepted for Bell's Rolled Cloth Asbestos Packing to sample submitted:—Elastic core ... ... Square.
" " ... ... Round.

To Mr. John Bell. JOHN COLLETT, Director of Navy Contracts.

BELL'S ASBESTOS BOILER PRESERVATIVE.—This useful mixture by absorbing the free oxygen that is in the water entirely checks pitting and corrosion. It also disintegrates incrustation so immediately as to prevent its adhering to the plates. Not only is a great economy of fuel effected in keeping boilers clean, but the risk of having the plates burned is thereby obviated. It has been computed that 1/16 in. thick of incrustation causes a waste of 15 per cent. of coal; ⅛ in., 60 per cent.; ¼ in., 120 per cent.

Thus the Preservative avoids the great risks which are inseparable from scale plates, lengthens the life of a boiler, and covers its own cost a hundredfold by economy of fuel.

It is entirely harmless, and has no injurious action on metals. It can be put into the feed tank or boiler, as may be most convenient.

Sold in drums and casks bearing the Trade Mark, without which none is genuine.

BELL'S ASBESTOS YARN and SOAPSTONE PACKING for Locomotives and all Stationary Engines running at very high speed with intense friction.

Sandwell Park Colliery, Smethwick, 1st February, 1884.

To Bell's Asbestos Works.

DEAR SIRS,—I have much pleasure in stating that I have used your Asbestos Packing for the last 13 months for our large winding engines which are running night and day, and also for the fan, pumping, and hauling engines at the above Colliery, and during that period we have not used more than one-third the Packing we had formerly; and this I attribute to your Packing on account of its great durability and general excellence of quality.

I am, dear Sirs,
Yours faithfully,
THOMAS WINTER, Colliery Engineer.

TRADE MARK.

BELL'S ASBESTOS.

The goods of this house are of the highest quality only, and no attempt is made to compete with other manufacturers by the supply of inferior materials at low prices. All "home" orders should be sent direct to the undermentioned depôts and not through Agents or Factors.

BELL'S ASBESTOS BOILER AND PIPE COVERING COMPOSITION, for coating every class of steam pipes and boilers, non-combustible and easily applied when steam is up; adheres to metals and preserves them from rust; prevents the unequal expansion and contraction of boilers exposed to weather; covers 50 per cent. more surface than any other coating, and is absolutely indestructible. It can be stripped off after many years' use, mixed up with 20 per cent. of fresh, and applied again. The composition is supplied dry, and is only to be mixed with water to the consistency required for use.

A Horizontal Boiler, 17 ft. 6 in. long, 15-H.P., gave the following results:—
Temperature on Plates - - - 186 deg.
" " Covering - - 94 deg.

One ton of coal was saved per week, and although the fire was raked out every evening, 20 lbs. of steam were found in the boiler next morning.

The following Testimonials refers to this Covering:—

Offices of the Wimbledon Local Board, Wimbledon, Nov. 28th, 1883.

DEAR SIR,—It may interest you to know that we save exactly 40 per cent. in fuel through using your covering. Yours truly, W. SANTO CRIMP, C.E., F.G.S.

The Tamar and Kit Hill Granite Company (Limited),
Gunnislake, Tavistock, 8th April, 1884.

Mr. John Bell, Southwark, S.E.

SIR,—I have much pleasure in stating that the Asbestos covering applied by you to the boiler of our travelling crane at Kit Hill has yielded most remarkable results. Since it has been in use we have saved fully half our coals, and have effected a great saving in the time it takes to get up steam, which is often a matter of great importance to us. I should add that the crane runs on high gantries, and is fully exposed to all weather. I have formed the highest opinion of your Asbestos as used for this purpose, and as you are aware, have had another boiler similarly covered, though it has not since been used. I can most strongly recommend the material.

I am, Sir, yours faithfully, W. J. CHALK, Assoc. M. Inst. C.E., Engineer and Manager.

BELL'S ASBESTOS and INDIA-RUBBER WOVEN TAPE and SHEETING, for making every class of Steam and Water Joints. It can be bent by hand to the form required without puckering, and is especially useful in making joints of manhole and mudhole doors. It is kept in stock in rolls of 100 ft., from ⅛ in. to 3 in. wide, and any thickness from 1/16 in. upwards. Manhole covers can be lifted many times before the renewal of the jointing material is necessary. The same material is made up into sheets about 40 in. square, and each sheet bears the Trade Mark, without which none is genuine. It is very necessary to guard against imitations of this useful material, and to secure themselves against being supplied with these inferior articles at my price, users are recommended to see that every 10 ft. length of the Asbestos Tape purchased by them bears the Trade Mark.

BELL'S SPECIAL LONDON-MADE ASBESTOS MILLBOARD, for Dry Steam Joints, made of the best Asbestos fibre, is well-known for its toughness and purity, and is absolutely free from the injurious ingredients frequently used to attain an appearance of finish, regardless of the real utility of the material. Made in sheets measuring about 40 in. square, from 1-64th in. to 1 in., and ½ millimetre to 25 millimetres thick. Each sheet bears the Trade Mark.

The following copy of acceptance of tender refers to above:—

Department of the Director of Navy Contracts.
Admiralty, Whitehall, S.W., 17th May, 1884.

SIR,—I have to inform you that your tender for Asbestos Millboard has been accepted.—Mr. John Bell. JOHN COLLETT, Director of Navy Contracts.

BELL'S ASBESTOS EXPANSION SHEETING (PATENT).—This Sheeting is another combination of Asbestos with India-rubber, giving to the steam user the special advantages of both materials. The India-rubber Washer is protected from the action of heat and grease by an outer coating of vulcanised Asbestos Cloth, thus producing an excellent joint where expansion and contraction render other materials unserviceable. This material is admirably suited to steam pipe joints and every class of valve. Valves made of this material are very durable, as they are not subject to injury by oil.

ASBESTOLINE
RD.

—THE BEST LUBRICANT FOR ALL KINDS OF MACHINERY ASHORE OR AFLOAT.—

2/3 Per lb.

1 LB. EQUAL TO 2 GALLONS OF BEST OIL.

BELL'S "ASBESTOS LUBRICANT."
"REGD"

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Victoria Buildings, Deansgate, MANCHESTER. 11 and 13, St. Vincent Place, GLASGOW. 46, James Street, Bute Docks, CARDIFF. 21, Ritter Strasse, BERLIN.

R. HUDSON'S

Patent Steel Trucks, Points and Crossings,

PORTABLE RAILWAY, STEEL BUCKETS, &c., &c.

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In connection with the Leeds Exchange, and all the principal Hotels and places of business in the town.

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(Near Gildersome Station, G.N.R. Main Line, Bradford to Wakefield and London, via Laisterdyke and Ardsley Junctions.)

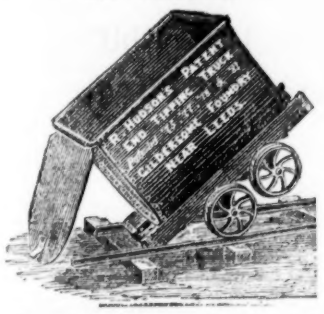
Registered Telegraphic Address:—"GILDERSOME, LEEDS." A. B. C. Code used.

UPWARDS of 25,000 of these Trucks and Wagons have been supplied to the South African Diamond Mines; American, Spanish, Indian, and Welsh Gold, Silver, Copper, and Lead Mines; Indian and Brazilian Railways, and to Railway Contractors, Chemical Works, Brick Works, and Coal and Mineral Shippers, &c., &c., and can be made to lift off the underwork, to let down into the hold of a vessel, and easily replaced. They are also largely used in the Coal and other Mines in this country, and are the LIGHTEST, STRONGEST, and most CAPACIOUS made, infinitely stronger and lighter than wooden ones, and are all fitted with R. H.'s Patent "Rim" round top of wagons, requiring no rivets, and giving immense strength and rigidity. End and body plates are also joined on R. H.'s patent method, dispensing with angle-irons or corner plates.

Patented in Europe, America, Australia, India, and British South Africa, 1875, 1877, 1878, 1881, and 1883.
N.B:—The American, Australian, Indian, and Spanish Patents on Sale.

CAN BE MADE TO ANY SIZE, AND TO ANY GAUGE OF RAILS.

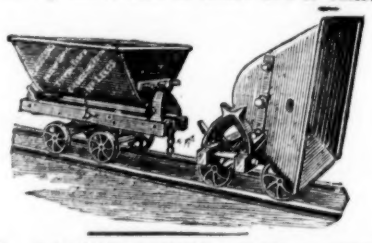
1.—PATENT STEEL END TIP WAGONS.



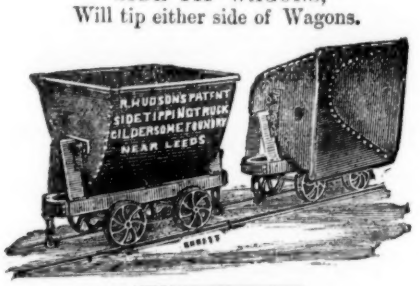
7.—PATENT STEEL MINING WAGONS.

12.—PATENT STEEL HOPPER WAGON, WITH BOTTOM DOORS.

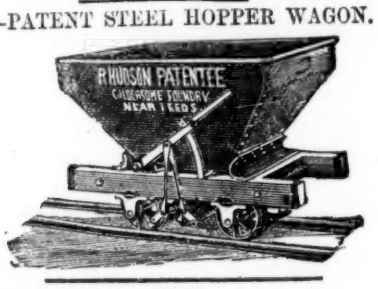
2. PATENT UNIVERSAL TRIPLE-CENTRE STEEL TIPPING TRUCK,
Will tip either SIDE or either END of rails.



8.—PATENT DOUBLE-CENTRE STEEL SIDE TIP WAGONS,
Will tip either side of Wagons.

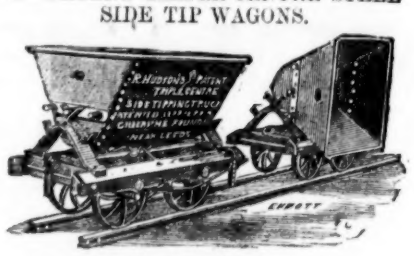


13.—PATENT STEEL HOPPER WAGON.

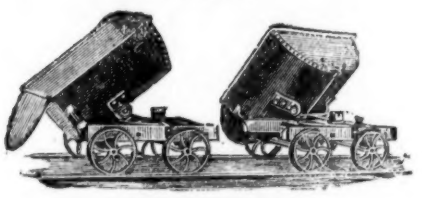


ONE man can EASILY tip ANY WEIGHT in these wagons.

3.—PATENT TRIPLE-CENTRE STEEL SIDE TIP WAGONS.

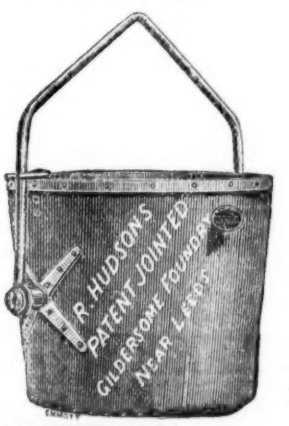


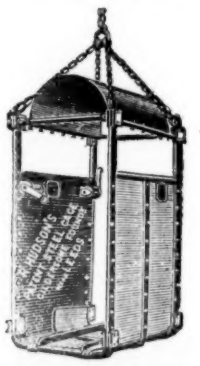
9.—PATENT STEEL ALL-ROUND TIP WAGON.



14.—SELF-RIGHTING STEEL TIP BUCKET.
(The "CATCH" can also be made SELF-ACTING if desired.)

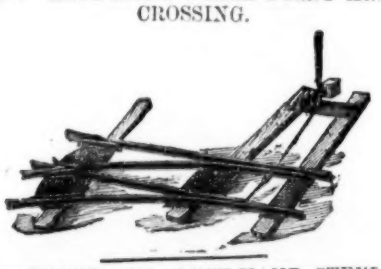
15.—STEEL CAGE.





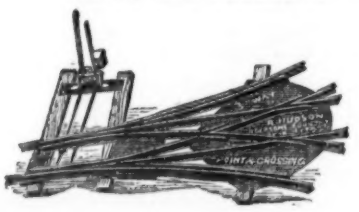
4. -PATENT STEEL PLATFORM OR SUGAR CANE WAGON.

10.—LEFT-HAND STEEL POINT AND CROSSING.



5.—PATENT STEEL CASK.
As supplied to H.M. War Office for the late war in Egypt).
DOUBLE the STRENGTH of ordinary Casks without any INCREASE in weight.
(Made from 10 gals. capacity UPWARDS to any desired size.)

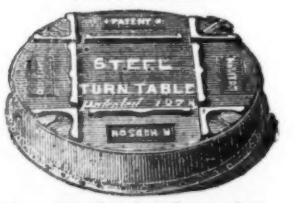
11.—RIGHT AND LEFT-HAND STEEL POINT AND CROSSING.



16.—PATENT STEEL WHEELBARROWS.
Made to any Size.
Lightest and Strongest in the Market.

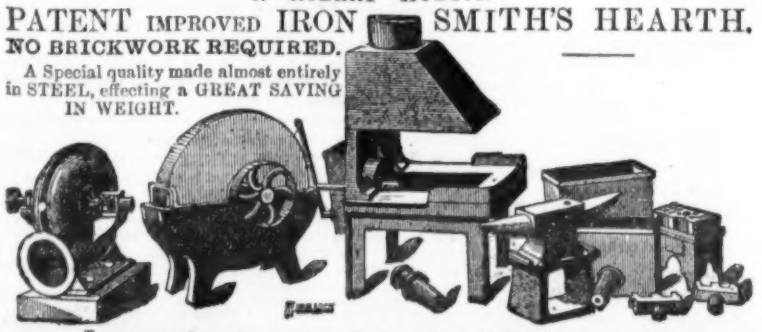
A great success.

17.—STEEL SELF-CONTAINED TURNTABLE.



(Also made in CAST Iron for use where weight is not a consideration.

6.—ROBERT HUDSON'S
PATENT IMPROVED IRON & SMITH'S HEARTH.
NO BRICKWORK REQUIRED.
A Special quality made almost entirely in STEEL, effecting a GREAT SAVING IN WEIGHT.



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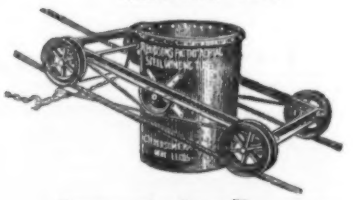

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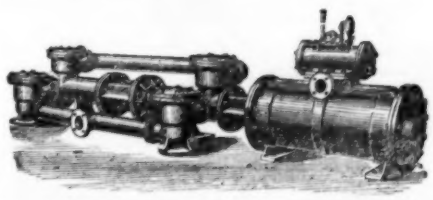

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AUSTRALIAN GOLD SYNDICATE.

MR. THOMAS CORNISH, M.E., author of "Our Gold Supply; its Effects on Finance, Trade, Commerce, and Industries," who has had great experience in practical gold mining in Australia and elsewhere, PROPOSES to FORM a SYNDICATE, with a moderate amount of capital, controlled in London, with the object of enabling him to investigate certain gold mining properties in Australia, with a view to the rights over them being acquired by the syndicate, and afterwards dealt with as they may think fit. Mr. Cornish's chief attention would be directed to properties partially developed, and fairly certain to be almost immediately dividend-paying, so that after any moderate expenditure they could be put upon the market as going concerns, with a certainty of considerable profit. In his work above mentioned Mr. Cornish shows that gold mining is a regular and substantial industry when properly undertaken by competent persons, that in the Australian Colonies since the discoveries of gold there in 1851 about £300,000 000 (three hundred millions of pounds) sterling worth of gold have been produced there, and that at a moderate computation one-third of this has been paid in dividends as net profits. Gold mining has become a steady industry there, and is gradually spreading.

One of the most recent openings up an auriferous country is in the Northern Territory of the colony of South Australia, where according to the Quarterly Official Report, issued last August, the mines were yielding an average of from 1½ to 2 ozs. of gold per ton of quartz. Here, as well as in Queensland, where the new gold fields are turning out equally well, there are very many favourable opportunities constantly being presented for the profitable operation of such an organisation as this proposed by Mr. Cornish.

Mr. Cornish proposes to act in conjunction and consultation with Mr. William Nicholas, M.E., F.G.S., lecturer on Practical Mining at the Melbourne University, and with a practical mining engineer of approved standing in London.

It is believed that a capital of £20,000, which it is proposed should be divided into shares of £10 each, would be ample for the purpose, and that this should be paid up—one-fourth on subscription, and the remainder in three quarterly payments.

Persons desirous of taking part in the proposed syndicate may communicate with Mr. CORNISH, at 3 and 4, Palace Chambers, Bridge-street Westminster.

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For Accountants, Merchants, Public, and Private Offices.
By WILLIAM WETHERED.

This work is applicable to calculations where any number of articles cost is given sum, and the price of one of such number is required.

The circulation of such a book as this must necessarily be limited. It is doubtful whether it will pay more than the bare cost of publishing, allowing nothing for the enormous amount of labour such a mass of figures has occasioned. The price cannot be named at less than 25s., and it is not too much to say that where it can be applied its cost will be saved in a few weeks. It will be found invaluable to accountants generally.

Copies can now be had, and will be forwarded from the MINING JOURNAL Office on receipt of Post Office Order for the amount.

Original Correspondence.

TRADE AND NAVIGATION OF THE UNITED KINGDOM, 1884.

Total value of imports (exclusive of bullion and specie) £389,774,549
Total value of exports (exclusive of bullion and specie) 293,371,290

Grand totals..... £683,145,839

The imports compared with 1883 comprise:—

1.—Living animals (for food) £10,524,875, showing decrease of	£1,454,121
2.—Articles of food and drink admitted duty free, £123,286,694, decrease	26,055,547
Articles of food and drink admitted dutiable, £25,647,725, decrease.....	2,284,548
Tobacco admitted dutiable, £2,776,936, decrease	122,666
3.—Metals, £16,806,056, decrease	862,035
4.—Chemicals, dyestuffs, and tanning substances, £9,545,227, decrease	184,132
5.—Oils, £6,497,796, decrease	781,337
6.—Raw materials for textile manufactures, £86,302,302, increase.....	1,540,597
7.—Raw materials for sundry industries, £40,982,405, decrease	4,369,838
8.—Manufactured articles, £53,264,334, increase.....	382,866
9.—Miscellaneous articles, £14,140,197, decrease.....	1,638,622
Total decrease	£35,829,383

The exports compared with 1883 comprise:—

.—Living animals, £614,217, showing decrease	£50,777
2.—Articles of food and drink, £10,462,341, showing decrease	166,200
3.—Raw materials, £13,469,551, showing decrease	6,367
4.—Articles manufactured and partly manufactured—	
A. Yarns and textile fabrics, £109,844,281, showing decrease	1,553,281
B. Metals and articles manufactured therefrom (except machinery), £37,162,152, showing decrease	3,383,869
C. Machinery and millwork, £13,051,028, showing decrease	382,053
D. Apparel and articles of person use, £10,784,805, showing decrease	544,924
E. Chemicals & medicinal preparations, £7,839,516, increase	49,346
F. All other articles, 29,699,684, decrease.....	833,773
Total value of British and Irish produce, &c., £232,927,575, decrease	£6,871,898
Total value of exports of Foreign and Colonial, &c., £62,443,715, decrease ...	£3,193,882
Total decrease	£10,065,780

Imports and consumption of the principal articles of foreign and colonial merchandise.—Arranged in the order of their money value, expressed in thousands of pounds sterling: Cotton (raw), 44,113*l.*; wool (sheep and lamb's), 26,114; sugar and molasses, 19,854; wheat, 19,825; wood and timber, 15,025; butter and butterine, 12,562; silk manufactures, 10,976; tea, 10,567; wheat, meal, and flour, 10,166; seeds (cotton, flax, linseed, and rape), 7574; Indian corn or maize, 7303; woollen manufactures, 6924; oxen and bulls, 6831; bacon, 6784; leather, 5411; wine, 5346; cheese, 4997; silk, 4582; barley, 4228; oats, 4195; hides, 3885; coffee, 3757; jute, 3602; fruit, 3127; flax, 3028; eggs, 2908; tobacco, 2776; iron manufactures, 2702; rice, 2683; indigo, 2484; beef (fresh), 2372; caoutchouc, 2267; copper (unwrought), 2241; cotton manufactures, 2235; sheep and lambs, 2149; tin, 2125; iron ore, 2112; tallow and stearine, 2096; hemp, 2077; oil seed cakes, 2037; hams, 1931; spirits, 1889; copper regulus and precipitate, 1795; petroleum, 1705; woollen-yarn, 1676; gloves, 1671; hops, 1619; currants, 1618; glass, 1618; lard, 1532; chemical manufactures, 1502; fish (cured), 1493; mutton (fresh), 1408; paper, 1404; meat (preserved), 1392; oil (palm), 1385; copper ore, 1378; pyrites of iron or copper or sulphur, 1214; cows, 1201; lead, 1158; iron (bar, angle, bolt, and rod), 1158; beans, 1151; esparto, &c., 1128; spices, 1037; nitre (nitrate of soda), 979; bark (peruvian), 906; raisins, 863; potatoes, 824; cutch and gambier, 820; cocoa, 793; drugs, 789; yeast, 778; oil (olive), 715; zinc (crude), 699; woollen rags, 678; peas, 669; poultry and game, 669; gums, 638; pork, 619; watches, 609; turpentine, 560; dyes (coal tar), 554; onions, 532; train oil, 531; valonia, 526; rags (for paper), 488; ivory, 483; goat's hair, alpaca, &c., 475; bristles, 471; gutta percha, 462; bones, 450; guano, 439; clocks, 436; vegetables, 426; beef (salted), 418; cocoa-nut oil, 398; zinc (manufactured), 391; seed oils, 384; resin, 376; boots and shoes, 351; quicksilver, 333; saltpetre, 306; calves, 257; horses, 256; bark (for tanning), 195; brimstone, 193; tar, 130; steel (unwrought), 88; pigs, 84; cochineal, 80; alkali, 70; chicory, 68; straw hats, 59; madder, &c., 31; Indian corn meal, 23*l.*

Table of the principal imports of food stuffs, arranged in order of their money value, expressed in thousands sterling:—Corn and flour, 47,562*l.*; sugar and molasses, 19,854; butter and butterine, 12,526; tea, 10,567; living animals, 10,524; bacon, 6784; wine, 5346; cheese, 4997; coffee, 3757; fruit, 3127; eggs, 2908; beef, 2790; tobacco, 2776; rice, 2683; hams, 1931; spirits, 1889; hops, 1619; currants, 1618; lard, 1532; fish (cured), 1493; meat (salted, &c.), 1455; mutton (fresh), 1408; spices, 1057; raisins, 863; potatoes, 824; cocoa, 793; yeast, 777; poultry and game, 669; pork, 629; onions, 532; vegetables, 426; and chicory, 68*l.*

Exports, British and Irish produce and manufactures:—Principal articles arranged in the order of their money value, expressed in thousands sterling.—Cotton manufactures, 58,925*l.*; iron and steel manufactures, 24,487; woollen and worsted manufactures, 20,131; machinery and millwork, 13,051; coal, coke, &c., 10,851; apparel, and articles of personal use, 10,784; chemicals, &c., 7839; linen manufacturers, 5178; hardware and cutlery, 3140; copper manufactures, 2568; telegraph wires, &c., 2509; jute manufactures, 2477; silk manufactures, 2172; fish (herrings, &c.), 2100; leather, 2016; earthen and china ware, 1835; arms, ammunition, &c., 1723; beer and ale, 1841; paper, 1532; seed, oil, 1465; pickles, vinegar, sauces, confectionery, &c., 1376; skins, &c., 1293; painters' colours, &c., 1293; carriages (railway), 1285; books (printed), 1171; sugar (refixed and candy, 1109; glass, 1050; caoutchouc, 1006; bags and sacks (empty), 1005; stationery, 847; wool, 824; spirits, 794; provisions (including meat), 780; horses, and other living animals, 614; salt, 613; rags, 561; soap, 547; tin (unwrought), 469; lead (pig, sheet, and manufactured), 422; cordage, 416; sadlery and harness, 380; cement, 370; plated and plated gilt wares, 321; candles, 213; butter, 204; red pottery and brown stone ware, 119; zinc (or spelter), 100; alkali, 70; hops, 52*l.*

Exports—Foreign and colonial merchandise.—The principal articles arranged in the order of their money value expressed in thousands sterling:—Wool, 15,334*l.*; cotton (raw), 5379; coffee, 3225; tea, 2440; hides, 1743; indigo, 1708; rice, 1675; iron and steel, 1299; tin, 1216; caoutchouc, 1155; jute, 1137; leather, 1010; oils, 997; spices, 714; bark (peruvian), 679; copper (unwrought and part wrought), 648; sugar, 618; corn and flour, 557; woollen manufactures, 548; silk manufactures, 532; wines, 510; spirits, 458; fish (cured or salted), 451; hemp, tow, &c., 419; tobacco, 399; cotton manufactures, 394; bacon, 374; silk, 368; gums, 366; butter and butterine, 355; seeds, 346; tallow and stearine, 328; ivory, 307; cutch and gambier, 292; quicksilver, 285; cocoa, 264; chemicals manufactured, &c., 226; oranges and lemons, 197; currants, 196; boots and shoes, 162; cheese, 159; raisins, 158; glass, 136; meat, 107; wood and timber, 89; guano, 86; paper, 78; lard, 72; cochineal, 64; gutta percha, 56; hops, 43; petroleum, 35; saltpetre, 28; chicory, 16*l.*

Declared real value of imports and exports of gold and silver bullion and specie registered in the year ended Dec. 31:—Imports of gold 10,720,358*l.*; silver, 9,601,495*l.*: total, 20,321,853*l.* Exports of gold, 12,017,839*l.*; silver, 9,986,386*l.*: total, 21,999,222*l.*: grand total, imports and exports, 42,321,075*l.*

Principal articles of imported merchandise (subject to duties of customs) remaining in the bonded warehouses of the United Kingdom, Dec. 31:—Tea, 118,901,663 lbs.; tobacco, 78,056,804 lbs.; spirits, 13,786,512 proof gallons; wines, 8,256,848 gallons; cocoa, 6,760,872 lbs.; currants, 426,175 cwts.; coffee, 422,567 cwts.; raisins, 112,160; chicory, 20,401.

Tonnage of vessels entered and cleared with cargoes from and to various countries during the year ended Dec. 31:—Foreign countries, entered, 20,708,667 tons; British possessions, entered, 3,988,018 tons; total, entered, 24,696,685 tons. Foreign countries, cleared, 23,961,422 tons; British possessions, cleared, 5,312,240 tons; total, cleared, 29,273,662 tons; grand total entered and cleared, 53,970,347 tons.

Tonnage of British and foreign vessels employed in the coasting trade (distinguishing those employed in the intercourse between Great Britain and Ireland) entered and cleared with cargoes, at ports in the United Kingdom, during 1884:—General Coasting Trade, entered—British, 17,318,256 tons; foreign, 112,636; intercourse between Great Britain and Ireland, entered — British, 9,273,069; foreign, 4687; total—British, 26,591,325; foreign, 117,323. General Coasting Trade, cleared—British, 15,422,835; foreign, 89,156; intercourse between Great Britain and Ireland, cleared—British, 8,656,569; foreign, 2083; total British and foreign entered, 26,708,648; total ditto ditto cleared, 24,170,643; grand total entered and cleared, 50,879,291 tons.

Gross amount produced by customs duties upon the principal and other articles of foreign and colonial merchandise in 1884:—Tobacco and snuff, 9,284,813*l.*; tea, 4,377,440; spirits, 4,222,174; wine, 1,243,010; fruits, 543,399; coffee, 206,428; chicory, 65,446; cocoa, 58,182; sundries, 26,942; money deposited and not appropriated to goods, 5509; total, 20,033,143*l.*

Memorandum.—Herein is a marvellous thing which comparatively few people take the trouble to analyse. It is simply impossible to comprehend fully the amazing annual totals of the Board of Trade and Navigation. For example, it is very easy to say that our imports and exports last year (including bullion and specie) were valued at 725,466,914*l.* sterling, and that the tonnage of vessels entered and cleared with cargoes from and to foreign countries and British possessions, together with vessels engaged in our coasting trade, amounted to more than 58,000,000 tons, and that we bought and paid 151,711,354*l.* for foodstuffs alone, but having said it Mr. Bull has no alternative but to thrust his hands into his breeches pocket forthwith, and exclaim, "My conscience!" that's what "nobody can find out." I know that these ponderous sums may be juggled with in various ways. Mr. R. Giffen is almost the only man who fairly deals with them. All I will say about them at present is a desire that some of your able correspondents would express their views thereupon, and to certain nations who sneer at us as "a nation of shopkeepers." See what a wonderful old curiosity shop it is; it might be a glorious place to loot, but as a Britisher I cannot help thinking that the business done in the past year overrides all other businesses (the croakers to the contrary notwithstanding), and that there is nearly enough tonnage on our waters to keep our "nice little tight little island" in tolerable repose for some time yet to come. We did not lose 35,000,000*l.* last year, we did not have it to lose, we only gained a proportion of that sum the less; that is a trifle to smile at. T. A. READWIN, F.G.S.

London, Jan. 14.

GOLD FIELDS OF NORTH QUEENSLAND.

SIR,—Many readers of the *Mining Journal* will be glad to learn that the yield of the quartz crushed in the Charters Towers gold field well maintains its quality—the average being from 1½ to 2 ozs. per ton. Warden Sellheim, in reporting to the Under Secretary for Mines upon the Charters Towers field for September and October states that the crushings have been of the usual satisfactory nature, as evidenced by the mill returns annexed hereto. The stone reduced in September was 5646 tons 15 cwts. 2 qrs., yielding 8445 ozs. 1 dwt 9 grs. of gold, at an average of 1 oz. 9 dwts. 21 grs. per ton. In October 5153 tons 4 cwts. 2 qrs. passed the stampers, giving 11,638 ozs. 2 dwts. 5 grs. gold, being at an average of 2 ozs. 5 dwts. 4 grs. From the amount and quality of the ground open at present it may be safely inferred that these averages will be maintained for many months to come, unless the want of water should cause the mills to stop operations. Some of the dams have become lower than I have ever seen them, and unless copious rain falls before long the reduction of stone must of necessity be suspended. Even the supply of drinking water is rapidly failing, as well after well is going dry, and the little that is obtained from these sources is of so deleterious a nature that typhoid fever must be the unavoidable consequence, although the general public, without realising the danger it is exposed to, stands by with apathy. I think this is a matter where the Government might with propriety interfere. If a few truck-loads of water were brought in from the Macrossan Bridge station, where the Government have ample pumping machinery, by every train that comes in from there, sufficient good drinking water would be available for the whole population, and an immense amount of illness hereafter would be averted. Very little outlay to the railway would accrue from such an arrangement, and the extra expenditure would be amply covered by some reasonable charge that might be made to the water-carriers that would obtain their supply from the railway station. I consider it my duty to draw the attention of the Government to a matter of such importance.

Mining operations are being carried on vigorously all over the field, and several new companies are being formed to contribute the capital for working promising ground systematically. I have granted a prospecting area for some new discovery in the direction of the "old 70 mile diggings. One of the hills in this locality appears to be capped by quartzose creccia, which exhibits traces of igneous action, and contains fine gold. From the similarity of occurrence with Mount Morgan, a certain amount of interest is attached to this find, and its importance will depend mainly on the quantity of gold that is contained in the stone. The stone is plentiful and easily got, and if water can be obtained at hand for crushing purposes, even a low yield would pay handsomely. I have nothing fresh to report from the Cape river. The sluicers are stacking their wash-dirt, and although they have, so to say, had no rain for nearly two years, they evidently have not abandoned hope that it may rain some day. At Surface Hill occasional rich finds occur, and are the means of keeping together a population of about 70 men. In the lease in the deep ground they have driven into wash that has not been disturbed before, and very nice gold is being got, but hardly enough yet to reimburse the leaseholders for their plucky calling. The return of the crushings for September, 48 mines crushed the 5646 tons 15 cwts. already mentioned, whilst that for October shows that the 5153 tons 4 cwts. were obtained by 36 mines. N. B.

Brisbane, Nov. 27.

AURIFEROUS WEALTH OF QUEENSLAND—THE MOUNT MORGAN GOLD FIELDS.

SIR,—As, notwithstanding all that has been done in the development of the mineral resources of Queensland, there are still many fields where British capital could be very profitably employed, I subjoin a full abstract of the report of the Government geologist—Mr. R. L. Jack—on the Mount Morgan gold field. It was laid before the Assembly on Tuesday, and contains much valuable information.

Brisbane, Nov. 27. N. B.

About 12 miles from Rockhampton, on the heads of Gracemere Creek, granite is seen in a gully. It is soft and decomposing, and is covered with boulders of a coarse ferruginous siliceous grit. Some 5 miles further is the Razorback Range, a sharp "pinch" on the road leading up to a tableland which stands about 900 ft. above the sea level. The rocks seen on the road are metamorphised strata, possibly belonging to the same formation which presents itself in a less altered form on the northern side of the granite. Similar country prevails till, in 5 miles more, Mount Morgan is reached.

In the immediate neighbourhood of Mount Morgan the "country rock" consists mainly of bluish-grey quartzite—a fine grained siliceous sandstone now more or less vitrified—full of minute crystals of iron pyrites and specks of magnetic iron ore; grauwackes of the ordinary type—hard fine grained sandstones, or mingled siliceous and felspathic materials, now somewhat indurated; and, lastly, occasional masses of shale hardened to a flinty consistency, and a few belts of serpentine. As the stratified rocks in this particular locality appear to have been in thick beds, and as their metamorphism has gone a considerable length, it is not easy to be certain of either dip or strike. The stratified rocks are, moreover, interrupted and intersected in every direction by dykes and other intrussive masses of dolerite (itself altered by the substitution of viridite for its angite or olivine), rhyolite, and other igneous rocks, the intrussive masses apparently occupying as much space as the remnant of the original stratified formation itself. This country rock is traversed by reefs of the ordinary description, as, for instance, the Golden Spur reefs, and the Crow's Nest reef, and the mundic reef, all of which contain a pretty fair amount of gold. Aneroid measurements give the altitude of Razorback as 90 ft., of Wall and Company's offices, near the No. 1 machine, as 705 ft., and of Mount Morgan, as 1225 ft. above the sea level.

The mine, which is at the summit of the mountain, is approached by a rather steep road, but the difficulties of haulage are lessened by tipping the stone into a shoot, an expedient which reduces the actual descent by horse-power to something like 300 ft. in a distance of about ¼ a mile. The work (apart from prospecting or exploring operations) is carried on in two quarries or faces. No. 1 cuts into the hill from a level of about 25 ft. below the summit, and is designed simply to remove the top of the mountain for the purpose of passing it through the stampers. No. 2, or magazine quarry, presents the aspect of a siding road cut out of a steep hill, and attacks the auriferous deposit at a level of about 100 ft. below No. 1.

The central portion of the upper cutting is a large mass of brown hematite ironstone, generally in great blocks (up to some tons in weight) with a stalactite structure, as if the iron oxide had gradually filled up cavities left in the original deposit. The ironstone contains gold of extraordinary fineness, which, however, after a little practice, can be detected in almost every fresh fracture. The ironstone is more or less mixed with fine siliceous granules. Gradually to right and left of the central mass the silica more and more replaces the ironstone. It is a frothy, spongy, or cellular sinter, sometimes so light from the enlargement of air in its pores that it floats in the water like pumice.

Fine gold is desimminated throughout this siliceous deposit as well as the ironstone. Near the west end of the cutting is a vertical dyke of kaolin mixed with fine siliceous granules, passing into pure kaolin, with some silicates of magnesia, including a fine variety of French chalk. I selected a number of specimens as characteristic of the various deposits of the upper cutting. These, when assayed by Mr. Karl Staiger, city analyst, Brisbane, gave:—No. 5. Stalactitic brown hematite from middle of cutting, 6 ozs. 11 dwts. gold per ton. —No. 6. Siliceous sinter veined with quartz, 4 ozs. 5 dwts. gold per ton. —No. 7. A mixed mass of iron and silica from the level of the road, last of the dyke, 5 ozs. 3 dwts. gold per ton.—No. 8. Ironstained siliceous sinter from west side of dyke, 16 ozs. 14 dwts. gold per ton.

The lower or magazine face presents a sort of fan-like arrangement of its various material. In the centre is a band (almost vertical), of brown hematite in large "bombs," with a mammilated bothyoidal or sometimes reniform appearance. To the right (east) is a nearly vertical deposit of aluminous iron ochre, followed by a mass (still nearly vertical) of red hematite in large cellular bombs. To the east is a broad mass of loose ironstained siliceous and aluminous material, which begins to lean eastward, like the outer feathers of a fan. A great mass of loose earthy red hematite, another of brown hematite weathering to iron ochre, another of red earthy hematite, and another of brown hematite in large (ton) blocks, appear in succession as the cutting is followed to the east. The magazine (near the east end of the cutting) is excavated in a fine white siliceous earth, and the cutting ends with a mass of soft earthy aluminite. Beginning from the west side of the nearly vertical mass of brown hematite first described, we pass in succession in going westward a band of yellow ochre, a broad belt of light siliceous sinter ironstained, and containing some angular fragments of the quartzite of the country rock, a belt of similar siliceous sinter mixed with earthy red hematite, and finally a broad mass of loose siliceous sinter traversed by siliceous veins, and containing some angular fragments of the country rock, the members of the series leaning more and more fan-fashion to the west as they recede from the central vertical bands. At the end of the cutting is a mass of magnesian and aluminous silicates, which is probably the prolongation of the dyke seen in the upper quarry.

Mr. Lyle, the manager, informed me that he had got prospects in every part of this cutting, with the exception of the siliceous earth at the magazine. This was corroborated by my own observations. I ground and washed a great number of specimens (of my own selection) from both the upper and lower cutting, and from every variety of material, and was surprised and delighted with the prospects obtained, in most cases from stuff which miners would regard as most unpromising. Mr. Staiger's assays of characteristic samples, selected from the lower cutting, yielded gold as follows:—No. 1. Brown hematite (from *b*), 3 ozs. 6 dwts. per ton.—No. 2. Red hematite from *g*), 6 ozs. 16 dwts. per ton.—No. 3. Aluminous rock from west of dyke. No gold.—No. 4. Siliceous sinter from among the aluminous rock, 3 ozs. 15 dwts. per ton.

Down the hill sides to the north, west, and south a similar deposit is everywhere met with—a frothy or spongy matrix, sometimes aluminous and sometimes siliceous, generally iron stained, and occasionally associated with large masses of red and brown hematite, but gold has as yet only been obtained from a few places away from the hill top, although naturally there has been vigorous prospecting (so far as possible in an unusually dry season) wherever the formation resembled that of Mount Morgan. Perhaps the deposit on the slopes is more aluminous and less siliceous, and contains less of iron oxides than on the hill top, but these are the chief differences, and the formation has evidently one origin throughout.

After a careful study of the whole formation I have come to the conclusion that nothing but a thermal spring in the open air could have deposited the material under consideration. The frothy silicious sinter agrees in every respect with the deposits of New Zealand and Iceland geysers, and of the still more wonderful hot springs of the Yellowstone National Park, so graphically and scientifically described by Dr. A. C. Peele. [Twelfth Annual Report of the United States Geological and Geographical Survey of the Territories, Part II., Section 2, "On the Thermal Springs of Yellowstone National Park." Washington: 1883.] The frothy and cavernous condition of the siliceous sinter of Mount Morgan may be accounted for by the escape of the steam while the silica was yet (after the deposition on the evaporation of the water) in the gelatinous condition so frequently observed in the deposits of hot springs. The aluminous silicates represent the familiar outbursts and flow of mud. The iron oxide appears to have been deposited in some cases along with the silica and alumina, and in others to have been deposited later—its solvent fluid having been, as it were, injected into the interstices, vesicles, and caverns of the silica and alumina. In some cases it may have been originally pyrites, as it now and then occurs in cubical hollows. Calcareous sinter is very common in siliceous springs, and its absence from Mount Morgan must needs imply the local absence of limestones among the rocks from which the spring was fed. The silica would be found abundantly in the quartzites and the alumina in the shales and grauwackes of the country in the neighbourhood, and possibly both silica and alumina may have come in part from a deep-seated underlying granite. The gold, and to some extent the iron, may have been dissolved out of the iron pyrites of such reefs as the Mundic reef seen in Mundic creek; the gold possibly by chlorine produced by the contact of hydrochloric acid, derived from the decomposition of chlorides, with manganese, which occurs sparingly in the form of pyrolusite along with the ironstone of Mount Morgan.

Allusion has already been made to the rhyolite dykes which intersect the metamorphosed stratified rock of the district. The rock may be thus described:—A hard, very fine grained, almost compact dark grey felsitic matrix, with numerous and large crystals of sanidine, and a few granules or blebs of quartz. Fragments of hornblende crystals occur, but so rarely that the mineral must he regarded as accidental. No aisgite; no olivine. Several of these dykes run from north-west to south-east through the area included in the plan,

one runs from north-east to south-west through mineral selection No. 75, and still further west (beyond the limits of the plan) a large—probably intensive— mass of rhyolite occurs. That the deposit left by the thermal spring is newer than the altered stratified rocks through which it has burst is obvious; and that it is even newer than the much later date when the rhyolite dykes filled up fissures in the stratified rocks is proved by the fact that the dykes are clearly seen in some instances to be covered over by the siliceous, aluminous, and ferruginous deposits of the springs.

But yet another circumstance helps us in our endeavour to ascertain the age of the outburst of the Mount Morgan hot spring. About a mile to the west of the mountain is a mass—apparently about 150 ft. in thickness—of horizontal bedded sandstone. It rests apparently at this point on a mass of rhyolite, but in other places it may be seen lying on the upturned edges of quartzite and grauwacke strata, similar in character to those of the country around Mount Morgan. The base of this formation is a fine volcanic dust. The upper beds are coarsely gritty, and, for the most part, siliceous, varying from white to brown and red, and containing occasional pebbles of quartz and quartzite. I recognise in it without hesitation, Daintree's desert sandstone, which I have traced from Torres Straits to Maryborough, and which lies unconformably upon, and is, consequently, newer than the strata of the Western Downs. The latter present strong cretaceous affinities.

Standing on the sandstone cliffs, so as to look to the east past the south side of Mount Morgan, the observer can descry across the valley of the Dee the familiar contour of horizontally bedded sandstone cliffs stretching north and south. As nearly as can be judged by the eye, they are on the same level as the cliffs on the opposite side of the valley, and there can be no doubt that the valley has been carved out of a once-continuous cake of horizontal sandstone. The question arises—Was Mount Morgan an island in the sea or lake in which the sandstones were laid down? In that case the hot spring was older than the desert sandstone. The answer is easily made. Had there been shores to this sea or lake where Mount Morgan now stands, the sandstone in the neighbourhood would have been full of pebbles of sinter and ironstone derived from the waste of such easily degraded rocks. But I saw none such, and I believe they do not occur. The hot spring, then, was newer and not older than the desert sandstone.

In many places in the North the valleys carved out of the desert sandstone became theatres of volcanic activity. Among such places are the M'Ivor river, north of Cooktown, and the Mulgrave river, near Cairns. These volcanoes burst out near the heads of the valleys and filled the lower reaches with flows of basaltic lava to which we owe some of the richest agricultural land in the colony. Another form of volcanic activity was developed at the same period near the head of the Dee Valley. After the desert sandstone had been unlifted, and the carving out of the present valleys had been carried on for long ages—in fact, till the valleys had nearly acquired their present contours—basaltic lavas flowed down the valleys over the upturned slates of the M'Ivor, and over the auriferous drifts of the Mulgrave, and a geyser of enormous proportions spouted fitfully in the Valley of the Dee, carrying with it not only water, but in all probability, chloride of gold.

The Mount Morgan geyser, as well as the M'Ivor and Mulgrave volcanoes, probably date from tertiary times, and are contemporaneous with many of the basalts which cover auriferous drifts in Victoria. In the presence of so much ironstone a precipitant for the gold need not be far to seek. Protoxide of iron was probably present in sufficient quantities to perform this important function, but it may have been aided by tannic acid derived from vegetable matter accumulated in the basin. Several instances of the occurrence of vegetable matter in the basin of hot springs in the Yellowstone region are recorded in the report already quoted. Precipitation of the gold by means of tannic acid would accord better with the confinement of the gold to the basin or crater of Mount Morgan (to be afterwards alluded to) than precipitation by ferrous oxide.

I have laid down on the map the limits of the overflow deposit from the geyser. It would be next to impossible, and I believe it would be useless, to map out the limits of siliceous sinter, aluminious deposit, and ironstone, merging as they do into one another by insensible gradations, and imperfectly exposed as they are on hillside and in gully. The outer boundary of the overflow deposit is, in some places ill defined, as the "country rock" is frequently impregnated with aluminous, siliceous, and ferruginous material, so as to be distinguishable with difficulty from the unmixed deposit. That the deposit does not extend far to the east of Mount Morgan is owing simply to denudation, the deposit having been removed from the steep slope of the hill on that side.

In such active geysers as are accessible to observation, we find a narrow pipe or fissure, terminating upward in a crater-like cup or basin. The Great Iceland geyser, for example, has a pipe 12 ft. in diameter, which has been sounded to a depth of 70 ft. I have seen no satisfactory explanation of the necessity for a cup, nor can I suggest one, but all the same, the repeated occurrence of the cup evidently takes place in obedience to some natural law. It may be taken for granted that the Mount Morgan geyser was no exception to the rule, and I believe that that upper portion of the mount where ironstone predominates, and to which gold is almost confined, represents a basin occasionally filled with a fluid, in which silica, iron, alumina, manganese, and gold were held in solution, to be deposited when the bulk of the water from time to time withdrew into the pipe or the subterranean reservoirs with which the pipe communicated. The overflow of the ejected fluid left a siliceous, aluminous, and ferruginous deposit on the slopes of the hillside, but the gold does not appear to have been deposited to any extent beyond the limits of the basin. It may be remarked that "prospects" of gold have been obtained in a few localities in the overflow deposit. In such cases it may be a question whether the gold was carried down with the overflow, or whether it emanated from some of the subsidiary springs, which in such cases, as our experience of active geysers has shown, are pretty sure to break out in the vicinity of the main outflow. "Collan's Knob," for instance, is suggestive of one of the smaller springs.

Can any idea be formed as to the amount of gold to be obtained from the cup of the Mount Morgan geyser? I fear that as every item of the calculation would have to be preceded by an *if*, the answer would be of little value. The sectional area of the cup deposit is only approximately known. The depth of the cup deposit is not known at all, further than that it must be less than the difference between the levels of the summit of the hill and the bottom of the Dee valley. Lastly, the distribution of the gold throughout the whole of the cup deposit is a pure assumption, in making which we are not assisted by a knowledge of any analogous case in Nature. But the amount of auriferous stone at present in sight is enormous, and there is no rashness in believing that it extends over a large area, and to a considerable depth. The company have 25 heads of stamps erected, although only five heads were at work at the date of my visit. Water was very scarce, and it was evident that operations even on that limited scale might soon have to be suspended. In the meantime provision is being made for the storage of an abundant supply of water, so that the crushing may be carried on in an adequate manner after next wet season. Chlorination works are also being tried. No returns of crushings have been made, and, therefore, I am unable to give an average return. Mr. J. W. Hall estimated the stone awaiting crushing to contain on an average 10 ozs. of gold to the ton. Whether this is a fair estimate I cannot say, but I satisfied myself from numerous test-prospects that the gold contents were very good. I should judge over rather than under the average of Staiger's assays. It is obvious that when gold is so exceedingly fine as that of Mount Morgan a large proportion of it cannot be saved by the ordinary process, as many of the fine particles will not settle during the brief rush of the water over the mercury.

The discovery of gold in Mount Morgan is one of the most important events in the history of the mining industry. It is not merely that the quantity is large, and that certain shareholders will be enriched, but the possibility that the discovery may lead to others of equal importance in a direction where gold has never hitherto been looked for lends it a wider significance. A vast area in our western interior is covered with cretaceous rocks, and has been covered with the desert sandstone, of which isolated table-lands remain to attest its former wide extension. Beneath the cretaceous rocks palæozoic rocks undoubtedly extend, and these doubtless contain many reefs as rich in gold as those which are exposed to view in the ranges near the coast. Given a hot spring rising from depths in which auriferous reefs lie hidden we may look for a repetition of the phenomena of Mount Morgan. My own acquaintance with the west has been limited, but I have long suspected that the opals and ironstones met with in certain western localities had something to do with hot springs. I have heard many tales of "craters" among the desert sandstone and cretaceous regions of the West, and in some instances I suspect that my informants may have been describing geyser deposits. I should look in such places now with a keener interest, and with an eye to the chances of gold discovery. The subject will doubtless receive the earnest attention of prospectors. A few hot springs exist in Queensland at the present day, and several cases of "mud puffs" have been noted; but there is every reason to believe that the remains of extinct springs, dating, like Mount Morgan, from tertiary times, may be widely distributed. I do not mean that the search for extinct hot springs should be confined to the western downs. My object is to point out that gold may yet be found over that enormous area, where it has hitherto been regarded as hopelessly buried beneath mesozoic and tertiary accumulations.

ROBERT L. JACK.

Geological Survey Office, Townsville, Nov. 8.

MINING NEWS FROM SOUTH AFRICA.

SIR,—In last week's *Mining Journal*, in speaking of the Kimberley Central Diamond Mining Company and its prospects as reported in the Cape Argus, the writer uses the following words:—"The debts of the company amount to 170,000*l*., of which 80,000*l*. is due to the bankers and others, and 90,000*l*. to those connected with the mine."

This is not correct, and if uncontradicted will convey an erroneous impression to the public and those not intimately connected with the Kimberley Central Company. I will now give you the words of the Chairman of the Central Company (as reported in the Daily Independent of Saturday, Dec. 13, 1884), which he used at the half-yearly meeting on Dec. 12 last:—"According to the statement read to you, you will find that the actual debt of the mine is only about 170,000*l*.; 80,000*l*. is owing to people outside the mine not connected with the mine, banks, and others, and 90,000*l*. to people connected with the mine—about 170,000*l*. It may be a very large item, and is comparatively; but still is a very small item compared with what the resources of the mine are capable of meeting—in fact, I may say this company itself in the year ending April, 1883, of the company's existence it alone paid 240,000*l*., and the debt of the mine is 70,000*l*. less than what we paid in one year." The distinction which must be borne in mind is between the company and the mine; the Central being only one company of several in the mine will only be liable for its share of the 170,000*l*. debt of the whole mine. As a shareholder in the Central I think it right to call attention to the paragraph in your paper, which as it stands is misleading, and does not represent the actual state of the Central Company's affairs.

In conclusion, I can only use the words of the Chairman in closing these observations of the half-yearly meeting on Jan. 12, and express the hope that we may all be able to hold out long enough to participate in the good things in store for the Kimberley Central Diamond Mining Company. SHAREHOLDER.

Bovey Tracey, Jan. 15.

MINING NEWS FROM SOUTH AFRICA.

SIR,—In last week's *Mining Journal*, under this heading a grossly incorrect and misleading statement is made in regard to the Kimberley Central Diamond Mining Company. The paragraph mentions that "the debts of the company amount to 170,000*l*., of which 80,000*l*. is due to the bankers and others, and 90,000*l*. to those connected with the mine."

As a large shareholder in this company, I feel justified in calling your attention to such a statement, and, for your information, I may mention that the company referred to has on its depositing floors about 60,000 loads of "blue," if not more. However, taking these figures, this quantity, after allowing for outside cost in manipulation, will return them, at least, 75,000*l*., which, apart from fairly good work which is going on at the present time, will leave them a considerable balance to the good, after paying their debts as shown by the account now to hand. SHAREHOLDER.

Old Cavendish-street, Jan. 15.

GUINEA COAST GOLD MINING COMPANY.

SIR,—I have written the directors of this company a letter, of which I subjoin a copy, in the hope that you will let it appear in your columns, so that my fellow shareholders may see what I have said, and what information I have asked for from the board.

At the general meeting last year Mr. Johns stated that the directors were quite willing to give the shareholders every information. As a large shareholder I shall feel obliged by your informing me on the following points:—1. How was it that when you purchased the Izrah property you did not have it examined by a competent and wholly disinterested mining expert on behalf of the company? And I have to observe on this point (a) that it is the invariable practice for purchasers, either personally, or by an agent, to examine property which they buy before they pay for it. (b) That no member of your board would dream of neglecting this precaution, if acting on his own individual account. (c) That as two of the members of the board profited largely by this omission, it was all the more unjustifiable, and from most points of view quite inexplicable.

2.—The directors having agreed to purchase the reef, without any examination, but relying entirely on the vendor's statement, the very least they could have done would have been to have required him to enter into such covenant, or give such guarantee, in return for the 75,000*l*. he was paid, as would have given the company some kind of remedy against him, in case what he affected to sell them had no real existence, but the directors, in fact, took such a conveyance as left them entirely at his mercy when they found they had been deceived. Who is responsible for this almost criminal carelessness—carelessness that cost this company 85,000*l*.?

3.—The prospectus speak of a rich reef, only waiting to be crushed, in order to give profits, and the directors say that to avoid delay they had then already taken steps about the necessary machinery. Immediately the company was floated, however, this implied promise at once to procure machinery was quietly ignored.

This requires explanation, for if the directors really did believe in the existence of this reef, why did they deliberately break faith with the shareholders? It was in that case a wanton breach of faith altogether. If, on the other hand, they had the slightest doubt about its existence how is it possible to justify the payment of the 75,000*l*. to the vendor?

4.—The company was formed for a definite and specific purpose—to work the Izrah reef. There may have been some general power in the Articles of Association giving the company power to buy and work other property. But I entirely deny any moral right in the directors to embark in an entirely fresh speculation without first consulting the shareholders, whose servants they were for a specific purpose only. If the directors believed themselves fairly and honestly entitled to start this new venture, why did they so carefully conceal the fact from their employers?

5.—In the report for 1883 and at the general meeting the resolution to abandon the Izrah property, though at that time resolved on, was studiously concealed. How can this policy of duplicity and secrecy be defended?

6.—In October and November, 1883, the directors sent out circulars framed with the express purpose of inducing the shareholders to believe that "the mines" they then spoke of were the Izrah mines. A casuist might be able to distinguish between this sort of conduct and deliberate falsehood; for my part I am unable to do so.

There are several other questions that require explanation; for instance, why was 800*l*. paid Capt. Burton to go out and take possession? It was too late for him to examine the property, as it was paid for (and, besides, he was not a mining expert), nor was there any dispute about boundaries or title. Why was the result of the assay of his samples of quartz concealed? Why was the result of the trial of the hydraulic process kept back? Why did Mr. Peddie retire? Why has no quotation for the shares on the Stock Exchange been obtained?

Questions 1 to 6 are the most serious; but I believe the shareholders are entitled to require full and explicit information on all the points I have noticed, and I trust that you will give it to us either in your next report or at the general meeting for 1885.

We are entitled to have this information, and we should insist on having it.—*New Broad-street, Jan.* 10. P.

LEAD MINING IN THE LAKE DISTRICT.

SIR,—On making my new year's tour through this district I was sorry to hear of a rather serious breakdown to the pumping machinery at the Brandley Mines, and on enquiry was astonished to find that one of the massive cog-wheels of the pumping-engine had given way. This had the effect of temporarily filling the whole of the deepest workings with water. On my calling at the mines I found all straight again, and the workings drained to the pit bottom. It appears that owing to the breakdown the contractors who were sinking the engine-pit have given up, and that the company's men are now sinking. I saw splendid ore coming up out of the pit bottom, as solid as wax, and large heaps of it on the new dressing-floors. Powerful water wheels and crushing rollers are on the ground in course of erection, and all appears to be of the most modern kind and exceptionally strong, and the underground workings I am told are well filled with "bouse" (lead ore), and the crushers will have plenty of work to do to keep pace with the output from this grand old mine.

At Threlkeld Mine the deeper workings are said to be getting richer both in lead and blende. The output of about 150 tons per month is being maintained, and the fortunate proprietors are receiving good dividends, and are likely to for many years to come.

At Barrow Mine sinking operations are going on, and pumping machinery is being delivered for water-power. There are very large heaps of bouse on the surface here, and the composition of the vein is of a true lead-bearing nature. This mine will—with a little more capital expended—become a powerful rival to Threlkeld, Brandley, and Greenside Mines, and it is my opinion will pay quite as well as either.

At Thorthwaite Mine the water-wheel and pumps are at work, and I am told good discoveries of lead and blende have been made; a little more vigour in working is desirable, but possibly the low price of lead may be the cause of the workings being restricted.

At Yewthwaite Mine there seems to have been nothing done since my previous visit. This "dog in the manger" policy ought not to be permitted. The mine will pay well to work, and it is to be hoped that in the interests of lords, shareholders, and workmen that spirited working will at once be adopted. SKIDDAW.

Jan. 15.

SCIENTIFIC RECREATIONS FOR PRACTICAL MINERS.

SHORT, POPULAR, INSTRUCTIVE PAPERS FOR WORKING MINERS.*

BY EDW. DAVID HEARN, M.A., D.C.L., ETC.

MATHEMATICS†—INTRODUCTION—No. 1.

"Go on, dear youth, the glorious path pursue
Which bounteous Nature kindly smooths for you;
Go, bid the seeds her hand hath sown arise,
By timely culture to their native skies;
* * * * * * *
Whilst Fame, who longs to make true merit known,
Impatient waits to claim thee as her own." COCKBURN.

Mathematics has been, perhaps, most accurately defined as the Science of Quantities, or the science which points out the method of measuring quantity; and quantity or magnitude is defined to be anything capable of increase or diminution. Hence, a great mathematical authority of the last century correctly stated that "the business of mathematics in all its parts, both theory and practice, is only to search out and determine the true quantity either of matter, space, or motion, according as occasion requires. The consideration of these, according as they may be proposed, are the subjects of mathematics, but chiefly that of matter. Now, the consideration of matter with respect to its quantity, form, and position, which may be either natural, accidental, or designed, will admit of infinite varieties; but all the varieties that are yet known, or indeed possible to be conceived, are wholly comprised under the due consideration of these two—magnitude and number—which are the proper subjects of geometry, arithmetic, and algebra. All other parts of mathematics are only the branches of these three sciences, or rather their application to particular cases."

Now, a quantity can be measured or determined only by comparing it with some other quantity that is known, and observing the relation that one bears to the other. For instance, if we wished to determine the quantity and value of a sum of money, we must take some piece of money that is known, at a dollar, a pound, or a franc, and point out how many of such pieces are contained in the sum given. Again, if it were proposed to determine the quantity of a weight, we must take a certain weight that is known as a pound, a ton, or a kilogramme, and observe how many times anyone of them is contained in the weight in question. If we wished to measure length or extension, we should take a certain known length as a metre or a foot, and so on. Thus the determination or measure of magnitude of any kind resolves itself to this—Take any one known quantity of the same kind as that to be determined as the measure or unit; and then determine the relation which the proposed quantity bears to the known quantity. This relation is always expressed by numbers, from which it follows that a number is nothing more than the relation which one quantity bears to another taken arbitrarily as the unit. Consequently all magnitudes can be expressed by numbers, and the foundation of all the sciences of mathematics must consist in a complete treatise on the science of numbers and in a correct examination of the different methods of calculation. This fundamental part of mathematics is called Algebra, in which the numbers are considered only as representing quantities in general, without investigating the particular kinds of quantity which are the subject of other branches of mathematics. Numbers are particularly treated of in Arithmetic, which is the science of numbers properly so called, but this science extends itself only to certain methods of calculation which present themselves in ordinary practice. Algebra, on the contrary, comprehends generally all the cases which can be met with in the doctrine and calculation of numbers.

After considering these facts it will not be surprising that Algebra has been declared to be one of the most valuable, sublime, and scientific of all human inventions; since to thinking and intelligent beings it affords a rich source of gratification, enabling them to find out general rules for the solution of all questions that relate to quantity, and lays the foundation of great and noble acquirements. By its general and comprehensive nature it not only aids the reasoning faculties in the development of mathematical truths, but it also assists us in arranging our thoughts on other subjects. It is far superior, says the writer who expresses this opinion, in many respects to both arithmetic and geometry, as by it may be solved problems or questions which are quite beyond the reach of either. It would be vain to attempt to enumerate the various subjects, both practical and theoretical, to which this truly admirable art is applicable. By a train of reasoning founded upon simple mathematical principles we may often discover in a few lines more important truths than can be found in volumes. Algebra is not only useful to the mechanic, the astronomer, the engineer, the architect, and to workmen and professional men generally, but a knowledge of it ought to

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† The earlier mathematical papers will necessarily be very simple, and perhaps, therefore, less generally attractive; they will, when practicable, be made to accompany another paper. The introductory sketch now commenced will be concluded in next week's *Mining Journal*.

be considered as forming a principal part of a good education, for no one can be acknowledged an accomplished scholar who is ignorant of its principles.

When a student is tolerably versed, says Gregory, in the ordinary operations and principles of arithmatic and algebra, he is placed on vantage ground of which the master must at once show him how to avail himself. Geometry can, in truth, proceed but a little way without arithmetic, and the student should from the beginning pay strict attention to the distinction and connection between number and magnitude—one of the most difficult points in the investigations of mathematics. The connection between number and magnitude was first made by Euclid in his fifth book—a professedly obscure book for the learner, and yet in the pure Greek editions, contemplated logically, one of the most unobjectionable treatises ever written. He who permits a student to enter upon Euclid's fifth book without showing that its topics and its reasoning are altogether different from what has preceded, may enforce the practice of getting by rote, but does not teach geometry. It is essential that the student should early be made to comprehend that the doctrine of Proportion is in truth the basis of mathematics; and by exemplifying and enforcing this by the joint aid of arithmetical and algebraic considerations, still further illustrated and confirmed by the doctrines of Euclid's fifth and sixth books, the teacher will render his pupil permanent service.

Again, the student must be very careful to distinguish number; that is, abstract number, and quantity or magnitude, the first regarded as including the notion of times or repetitions, independently of the things counted or repeated; the second considered as whatever is made up of parts not differing from the whole in any respect but that of being less; and then if he be put upon the inferences susceptible of being deduced from the consideration of a part and the whole, he will perceive that they are only two, the first being "the part is less than the whole," the second, "the whole is greater than a part." He will thus learn to distinguish between a definition and an axiom, and will quickly comprehend the joint use of definitions and axioms, and their consequent tendency to give cogency and certainty to that progressive reasoning which distinguishes the mathematical from the ordinary logic. The student must early learn the essential distinction between an inert and passive reception of the truths of science (as though the mind were a mere vessel), and the active search after it, with a view to the full possession of all its advantages in extending and sharpening the intellectual powers, as well as in directing and improving the practical applications. To this end he must regard the information given as that which, in the writer's opinion, is best adapted to the purposes in view and in the main correct; but he must never consider it as in all cases infallible—the conviction which it carries is to be sought in the evidence which it produces. The student must learn to seek, outweigh, and estimate that evidence to ascertain what portions of it may be unhesitatingly received and made his own, what portions rejected, and what may be taken with a kind of suspended acquiescence until further light renders it clear whether they may be safely adopted or must be set aside altogether. He will thus become capable of distinguishing between theorising without intellect and by means of it; and, in consequence, between performing an operation mechanically, as a mere machine, and working by a rule which springs from intelligence. These distinctions, rightly made, are the infallible key to ultimate success.

Pure mathematics, says Bacon, "do remedy and cure many defects in the wit and faculties intellectual; for if the wit be dull they sharpen it, if too wandering they fix it, if too inherent in the sense they abstract it." And accepting this view it will readily be understood how easily can be answered the objections which have frequently been raised against the study of mathematics as pursued at Cambridge, and in other universities similarly conducted. The whole question was very ably discussed half a century ago by Arthur Browne, of St. John's College. It has been urged, he says, that since the truths which this study unfolds have no relation to the concerns of common life, and that since a knowledge of the abstract properties of geometrical figures and analytical symbols has no tendency to make us either wiser or better than we were before, mathematics must of all subjects be least calculated to prepare the minds of students for whatever station in life they may hereafter be called upon to fill. It has been insinuated that while amid the variety of learned professions it would have been impossible to select a subject equally adapted to the wants of every student we have with singular impartiality selected one which is perfectly useless to them all. The complete answer to these objections is that those young men who seek the benefit of a university education are mostly intended for one of the learned professions, and that in order successfully to prosecute the studies which belong to their profession it is requisite that their minds should be well habituated to thinking, acute in the detection of fallacious reasoning, capable of retaining and arranging their ideas, and of conveying the truths which are perceived, into other minds by clear and legitimate argument. Now, if we consider the nature of mathematical pursuits we cannot fail to perceive how admirably they are fitted to discipline the mind and to give it those various qualifications which are required in the prosecution of other studies, for the science of mathematics consists of pure and abstract reasoning. Starting from the knowledge of a few truths respecting the laws of motion and the properties of matter, sufficiently established by experiment and observation, it enables us, by a series of legitimate inferences, to arrive at the knowledge of other truths, so vast in their nature that we might well have imagined them to lie beyond the reach of science.

Though mathematics may have been sometimes debased by being employed in the discovery of unimportant truths and in the solution of useless though curious problems, yet considering the insight they have given us into the laws of Nature and into the manner in which the bodies which compose our system are mutually affected, we cannot but regard them as wonderful evidences of the power of the human understanding. Though the investigation of the truths connected with the movements and character of the planetary system does not, as it might seem, lie beyond the limits of our mental faculties, yet it must still be remembered that it exerts those faculties to the utmost, and is only to be effected by means of such continued and laborious thinking as is inconceivable to those who are occupied in the business of the world. It is on this account that it becomes so well calculated to discipline the mind. If in the studies of after life it is required that the mind should be well inured to thought, powerful in the combination and arrangement of its ideas, and skilled in distinguishing between specious sophistry and legitimate argument, there is no kind of training which can compare with that which is afforded by the diligent study of mathematics; and the student will find that the habits of study and of thought which he has acquired during his mathematical investigations will give him such a decided superiority over those of equal talent, but who have not received the same mental discipline that he will soon be able to rival and surpass them. There is also another advantage arising from mathematical pursuits. In studying the writings of a man of genius, who, though his mind may not have been disciplined by severer studies yet possesses in himself a copiousness of pleasing and instructive reflections, we are often while the book is before our eyes delighted with the ideas it suggests, but no sooner is it closed than those ideas are forgotten, and we rise from the perusal of what once amused us no wiser than we were before. Those writers, however, who have been habituated to mathematical thinking, and with minds thus strengthened, have entered upon the investigation of other subjects, are generally found to have the art of making their instructions more lastingly impressive. Their writings (if the nature of the subject at all admits it) are mostly characterised not merely by the excellence and justness of each separate idea, but also by the obvious connection which exists between them, and by the skill with which they are arranged. Hence it is that after we have risen from the perusal of the writings of such men we can easily recall to our minds the ideas that were suggested, and by frequently recalling them familiarise ourselves with the whole train of thought which it was the intention of those writings to convey.

With regard to the history and progress of mathematics, it is asserted by Josephus that the mathematical sciences were the first which were cultivated by mankind, since the posterity of Seth observed the order of the heavens and the courses of the stars; and lest these inventions should slip out of the knowledge of men (Adam having predicted a two-fold destruction of the earth—one by a deluge and the other by fire) they raised two columns—one of bricks, the other of stone—and inscribed their inventions upon them, and if the brick one should happen to be destroyed by the deluge, that of stone which would remain, might afford men an opportunity of being instructed, and presents to their view the things which had been inscribed upon it. It has very truly been said that arithmetic, the art of figures, and algebra, the science of symbols constitute the lower and higher departments of mathematics; but that geometry is the principal branch, since it treats of the properties of lines, angles, surfaces, and solids, and is applied to mensuration, trigonometry, conic sections, and to every department of investigation in which lines and angles, surfaces and solids, are chiefly concerned. It should at all times be remembered that a person skilled in the use of figures is merely an arithmetician; if he be acquainted with that higher branch of calculation in which general instead of particular quantities are dealt with he is an algebraist; if he be proficient in Euclid's Elements he will be entitled to be designated a geometrician; but he must be skilled in all these branches, and master of such others as pertain to the determination of magnitude and quantity, before he can properly be called a mathematician.

CHEMISTRY—No. III.

Hitherto the elements have only been considered so far as relates to their power to combine with each other, although the practical man will find that it is frequently quite as essential to know the power of the elements and their compounds to replace each other as the proportions in which they combine. To facilitate the acquisition of this knowledge the study of the quantivalence of the elements is of paramount importance. In our table of elements we find, under the head of quantivalence a series of Roman numerals designating the class to which the several elements belong, considered according to their quantivalence; and for convenience in speaking of them they are called respectively monatomic, diatomic, triatomic, tetratomic, and so on, according to the number of standard atoms which one combining-equivalent of the element is capable of replacing. The atom, of which the weight is given in the table as the combining-equivalent is incapable of existing alone, the *molecule*, or double atom, being the smallest quantity of an element that can exist uncombined with another element; so that the molecular weight of hydrogen would be 2; and the molecular weight of nitrogen, 28; the molecular weight of the other elements being found in the same way by doubling the weight given as the combining-equivalent in the table. But, commencing with the molecule of hydrogen, H H, it will be found that one of the atoms of the molecule can be replaced by one atom of either of the monatomic elements; so that although the molecule of chlorine, Cl Cl, cannot be divided whilst alone, each atom of chlorine could unite with a single atom of hydrogen and two molecules of hydrochloric acid, HCl and HCl, will be formed. It will be understood, then, that the atom represents the smallest known combining proportion; whilst the molecule represents the smallest cluster of atoms that can exist separately, or in a free or uncombined state.

That chemical combinations take place only in accordance with fixed laws will now be apparent, and we shall also learn that there is a direct relation between the weight and the volume of the atom, which is not only very interesting, but capable of being turned to great practical advantage. The conversion of water into steam is one with which we are all familiar, and not a few of us have likewise observed the further change which takes place when steam is superheated. Now, the difference between these vapours and gases, such as oxygen or hydrogen, is only of degree and not of kind—they differ from each other only in requiring different temperatures to retain them as elastic fluids; the transition from a vapour, or temporary gas, to a gas, or permanent vapour, being too gradual to admit of any distinct line of demarcation being drawn; chemists, therefore, call all elastic fluids gases, whether they be permanent or temporary; and it is a remarkable fact that if one combining equivalent, by weight, of the several elements (for it is to be assumed that every element, by the application of sufficient heat, may be converted into gas) be taken in its gaseous form and examined, it will be found that they, with scarcely an exception, all occupy an equal space. From the far greater facility with which we can measure a gas than weigh it, this is frequently of great practical importance, we will, therefore, endeavour to learn something about the atomic-volume-weight, and certain facts connected with it. Of course we must, in the first place, have some standard to which we may refer, and it is evident that this standard should be the weight of a definite measure of the lightest element, because by adopting that standard the atomic volume weight of every other element will be obtainable by multiplication only, and not some by multiplication and some by division; the weight, therefore, of one litre of hydrogen at the centigrade zero of temperature, and when the barometrical pressure is 0·76 metre, is taken as unity, and one litre of hydrogen is, therefore, said to weigh one *unit*—its actual weight is 0·0896 gramme, and consequently we must use this number as a multiplier whenever we desire to know the actual weight of an element or compound whose atomic-volume-weight is expressed in units. We thus see that if one litre of hydrogen weigh one unit, one litre of oxygen will weigh 16 units, and one litre of chlorine will weigh 35·5 units, and so on for all other elements and compounds when in their gaseous state.

When elements in the gaseous condition combine with each other, they do not always occupy the same space as they occupied when separate; thus, the combination of one litre of hydrogen with one litre of chlorine, will form two litres of the compound HCl., and, of course, require a vessel holding two litres to contain it; but it is a curious fact, that if this two litre vessel contained one litre of oxygen we might add *two* litres of hydrogen without over-filling it; and even this is not all, for if the vessel contained one litre of nitrogen, we might add *three* litres of hydrogen without over-filling it; and further, if the vessel contained one litre of carbon we might add *four* litres of hydrogen and it would not overflow. From this it will naturally be concluded that the elements are not all subject to exactly the same law, or rather we might say that the law by which chemical combination is regulated has more than one section. We have learned that elements combine with each other according to their combining-equivalent, but it is found that one combining-equivalent of an element will replace, or be replaced by, one, two, or more combining-equivalents of another element; and according to the power which the several elements possess of combining with or replacing one standard atom (the atom of hydrogen is taken as the standard atom) they are classified as to quantivalence. When one atom or combining-equivalent of an element can unite with or replace one standard atom it is said to be monatomic the principal monatomic elements or *monads*, as will be seen from table of elements, being—Br, Cs, Cl, F, H, I, Li, K, Rb, Ag, Na, and Tl. Dealing with monads only it will be found that beginning with the molecule of hydrogen one of the atoms of hydrogen may be replaced by one atom of chloride to form HCl; and, again, the remaining atom of hydrogen in the HCl may be replaced by sodium to form NaCl (chloride of sodium, sodic chloride, or common salt). So the chlorine, in its turn, may be replaced by iodine form NaI: or the several elements may be replaced or substituted in various other ways, which will be learned hereafter. When one atom of an element can replace, or be replaced by, two standard atoms it is said to be diatomic; the principal diatomic elements or *diads* are—Ba, Cd, Ca, Ce, Cr, Co, Cu, D, G, Fe, La, Pb, Mg, Mn, Hg, Ni, O, Pd, Se, Sr, S, Te, Th, U, and Zn. Now, it will be observed with regard to these diads that when they unite with or replace a monatomic element they usually require two atoms of the monad to act concurrently; thus oxygen being a diad combines with *two* equivalents of the monad hydrogen to form water gas H_2O but one equivalent of oxygen will combine with *one* equivalent of the diad calcium, because their quantivalence is equal. In the same way the *triads* or triatomic elements are those which can replace, or be replaced by, three standard atoms; the principal triads are—Al, Sb, As, Bi, B, Au, N, P, and R. The combinations of triads with monads, diads, and triads take place upon just the same principle; thus, two equivalents of aluminium unite with three equivalents of oxygen and form. Al_2O_3 because two triads are equal to six atoms, so that the quantivalence is balanced; in the same way the quantivalence is balanced in $AuCl_3$, and also in H_3N, and in various other compounds. The tetratomic elements, or *tetrads*, are those which can replace or be replaced by four standard atoms; the principal tetrads are—C, Nb, Pt, Si, Ta, Sn, Ti, and Zr. In the case of compounds into the formation of which the tetrads enter, it will usually be found that the quantivalence is balanced upon the principle already explained.

The practical application of this knowledge will be readily understood, and with regard to the extent to which it may be applied, it will suffice to mention that when this classification according to the power possessed of combining with or replacing a given number of standard atoms is adopted, it will apply not only to the combining weights, but also with reference to the combining volumes of nearly all the elements except arsenic and phosphorus. Thus we have seen that an atom of a monad will combine with or replace one atom of another monad; whilst an atom of a diad can satisfy or become the substitute for two atoms of a monad or for one atom of a diad. In the same way an atom of a triad is equivalent to three atoms of a monad, or to one of a diad and one of a monad; and further, that an atom of a tetrad can satisfy or become the substitute for four atoms of a monad, or for two atoms of a diad, or for one atom of a monad and for one of a triad. So with regard to volume, we have learned that one volume of a monad in the gaseous condition is satisfied with one volume of another monad, the compound being described as belonging to the monotypic class—HCl, for example, is a monotype. In the same way one volume of a diad requires two volumes of a monad, and forms a compound of the diatypic class—H_2O is an example. Again, one volume of a triad demands three volumes of a monad, and forms a triatypic compound—H_3N is an example. And we have likewise seen that one volume of a tetrad will take four volumes of a monad, forming a tretratypic compound—of which H_4C is an example. That the compound resulting in all these cases will occupy only two volumes (owing to the condensation which takes place) has been already explained, and it is not improbable that sesquitypic compounds, or those consisting of two volumes of one element with three of another, are likewise condensed into two volumes only; as well as the monoses-quitypic compounds, or those consisting of two volumes of one element with five volumes of another.

In explaining the practical value of a knowledge of the combining equivalents of the elements, the compound carbonate of soda was, to facilitate the explanation, written Na_2O, CO_2, but it is more usual to consider such salts as more perfect compounds than such a formula would indicate, and to write them Na_2CO_3. Which formula more correctly represents the actual constitution of the compound it is almost impossible to decide, for although the exact proportions in which the elements unite with each other can be very accurately determined, it is not practicable when more than two atoms are brought together in the form of a chemical compound to examine their mode of arrangement, so that whatever theory be adopted as to the constitution of such compounds care must be taken not to regard it as infallible. Having observed this we will take one more glance at the acids, bases, and salts in order to understand the modern method of representing them. The acids we shall see are really nothing but hydrogen salts, and by regarding them in this light we shall have less difficulty in comprehending their constitution. The simplest form is that observed in hydrochloric acid, where a molecule of hydrogen, H H, unites with a molecule of chlorine, Cl Cl, to form two molecules of hydrochloric acid, HCl HCl. Next comes the class represented by nitric acid, HNO_3, which is constituted upon the type of an atom of water, H_2O, one of the atoms of hydrogen being replaced by NO_2, which is a monad; and we should here observe that the quantivalence of a compound does not seem to be dependent in any degree upon the quantivalence of the elements composing it, for although nitrogen is a triad and oxygen a diad the compound NO_2 is a monad. The third class of acids is represented by sulphuric acid, H_2SO_4, which is constituted upon type of two atoms of water, $2H_2O$ or H_2O,H_2O, where two atoms of hydrogen are replaced by one atom of SO_2, which is a diad. In like manner phosphoric acid is constructed upon the type of three atoms of water, $3H_2O$, where three of the atoms of hydrogen are replaced by one atom of phosphoric oxide, PO, which is a triad.

With regard to bases, we have already learned that a base is a compound possessing the power of combining with and neutralising acids. We have seen that a metal (then called a basyle) may enter into such a combination with oxygen as to form a base; but metals are not the only basyles (the compound H_4N being an example of a non-metallic basyle), nor is oxygen the sole element that can assist a basyle to form a base; thus, the basyles may form bases by union with sulphur instead of with oxygen, for it is found that the base, sulphide of sodium Na_2S is analogus to the base oxide of sodium, or soda, Na_2O, and such bases are usually distinguished from the ordinary oxygen bases by mentioning the name of the other element, and calling them sulphur bases. A salt has been already defined as the compound resulting from the union of an acid with a base or with a metal—it consists of a basyle in combination with a salt-radicle—and a salt is generally regarded as a hydracid (that is, an acid formed by the union of hydrogen with another element) in which the hydrogen is replaced more or less completely by a metal. By decomposing HCl with Na, the latter replaces the hydrogen and forms NaCl (common salt) the atom of hydrogen escaping—this gives an idea of the simplest form of salt. If the HCl be acted upon by a diad (say, calcium) two atoms of the acid, 2 HCl, are decomposed, the salt $CaCl_2$ being formed, and two atoms of hydrogen escaping. In these cases the salt-radicle is simple, but it is not always so; thus, if we act upon sulphuric acid, H_2SO_4, with a diatomic metal, such as zinc, Zn, one atom of the metal replaces two atoms of the hydrogen and the salt sulphate of zinc, $ZnSO_4$, is formed, two atoms of hydrogen escaping—here the basyle, Zn, is combined with a compound salt-radicle, SO_4, which we designate sulphion. As we have seen there are sulphur bases, so also there are sulpho-salts, the latter name being given to those salts which are constructed of basyles and salt-radicles which contain sulphur in place of oxygen.

Such is a brief outline of the leading principles of theoretical chemistry, which, it is hoped, will afford all the information requisite to enable the practical man not only to appreciate the value of chemical works bearing directly upon the special branch of industry in which he may be engaged, but also to derive the utmost benefit from the study of standard works upon the science; and as practical men too often express their abhorence of anything theoretical, it may be well to explain the sense in which the term theoretical chemistry is employed. It is used simply in contradistinction to practical chemistry, or that portion of the science which relates to the application of chemical knowledge to the production of substances of ordinary marketable value—such as industrial products generally—and not by any means to imply that the principles laid down have not been submitted to the test of experience. Practical chemistry is really the chemistry of manufactures, and we must remember that practical chemistry is dependent for its advancement upon a proper regard for theory, and that scientific chemistry can make no progress but that which results from a strict attention to practice. In our next paper we shall consider the principles of chemical analysis.

NEW USE FOR RESIDUAL PRODUCTS.—Mr. O. B. Monnett, Secretary of the Bucyrus (Ohio) Gas Company, writes us, says the American Journal of Gaslighting, that he has just been allowed a patent on a "sheep wash" preparation, which the inventor asserts is made up entirely of a waste gasworks product; but fails to tell what the residual is, although the information may come along in good time. Mr. Monnett claims that the material may be made a great source of profit in all countries where sheep raising is extensively followed. He says that the material costs producers but from 4 to 5 cents. per gallon, and that it will readily sell for 30 cents. Now that Mr. Monnett has secured the patent, perhaps he may furnish our readers with a description of the material and the specific manner of its application.

ON SOME DEPOSITS OF APATITE NEAR OTTAWA, CANADA.

BY PROF. W. BOYD DAWKINS, M.A., F.R.S.

The recent visit of the British Association to Canada has afforded Englishmen an opportunity of becoming acquainted with districts which they had previously known only by reputation; and it is not improbable that the result will be to encourage the investment of British capital in the industrial enterprises of Canada, and thus to ensure mutual benefit. At a recent meeting of the Manchester Geological Society, Prof. W. Boyd Dawkins read an interesting paper based upon his visit to the Ottawa phosphate region, and the subjoined abstract gives an outline of his views concerning it:—

DESCRIPTION OF MINES VISITED.—The apatite mines of Canada deserve more than a casual notice, not merely on account of their economic value, but because of the interesting facts which they yield, throwing light upon the history of mineral veins in general. September last I visited some of those in the district of Buckingham and Portland, and the following communication to the Society is the result of my observations, combined with those published by Dr. Harrington in the report of the Geological Survey of Canada, 1877-78. The district to which it refers is that known as the North Ottawa Phosphate Region, and those parts of it which I have examined consist of a cluster of mines on the Rivière du Lièvre, about 18 miles above Buckingham, a station on the Canadian Pacific Railway to the east of Ottawa.

On getting out of the train at Buckingham, a drive of 4 miles along a road almost impassable from the depth of the ruts, took us to a tiny wharf, and we embarked in a litte steam yacht, which swiftly carried us up a noble river, about as broad as the Thames at Richmond, and flowing between bold rocky hills covered with trees glorious in the bright colours of autumn. We land, and make our way along a track leading up to one of the wooded spurs, which showed as we left the river behind us, in the large blocks of veinstuff and mica lying in the ruts, that we were approaching the mines. The first vein which we examined is exposed in the shallow working at the outcrop, and is filled with massive apatite containing bunches of black mica of the species known as phlogopite. The mine in work some ¾ mile higher up is situated in a vein from 12 to 14 ft. wide (Fig. 1, No. 3, of the following list), and filled with various materials, apatite, mica, pyroxene, calcspar, &c., the apatite varying in thickness from 2 to 14 ft. The sides of the vein are in some parts clearly defined from the surrounding rocks, while in others they shade off into the pyroxenite rock of the district. It is a true fissure vein with a hade of 57° to the east. The workings had been carried on to a depth of about 140 ft. from the surface, a greater depth than any other similar mine in the country.

They were wet in some places, and the apatite was so decomposed as to take the form of pure sea-green sand, soft enough to be dug out. After examining the outcrop of another vein close by (No. 4 of the subjoined list) we visited the Emerald Mine, some 2 miles away, where open workings had been carried on on a large scale, and galleries had been driven to some distance into the rock. The vein here was from 12 to 30 ft. thick, and filled with various minerals, among which apatite and calcspar predominate. In Fig. 2 a portion of the vein is represented abont 30 ft. thick, as it appeared on our visit, one side of it being filled with massive apatite, and the rest with calcspar, in which crystals of apatite, some of gigantic size, were scattered irregularly. Most of the largest and most perfect crystals of apatite have been obtained from this mine, some weighing, as Mr. Allan informs me, as much as 1000 lbs. In one place the vein is intersected by a dyke of igneous rock, probably of dolerite, which is of later age than the vein is, since fills a fault by which the vein has been dislocated.

THE DIRECTION OF THE VEINS IN THE NORTH OTTAWA PHOSPHATE REGION.—The apatite veins which I examined, Nos. 3, 4, and 9 of the following list, do not agree in the direction of their strike or bearing, and when they compared with others in the North Ottawa phosphate region described by Dr. Harrington in the report above quoted it will be seen that in the district generally they have no uniform direction. The predominant strikes are east and west, north-east, and north-west by west.

BEARING OF APATITE VEINS IN NORTH OTTAWA PHOSPHATE REGION.

1. Portland	N. 15° W.	10, 11, 12. Templeton	E. & W.
2. Buckingham	N. 45° E.	13. Templeton	N. 85° E.
3. Portland	N. 56° W.	14. „	N. 78° E.
4. „	N. 40° E.	15, 16. „	N. 45° E.
5. „	N. 55° W.	17, 18. „	N. 35° E.
6. „	N. 30° W.	19. „	N. 17° E.
7. „	N. 15° W.	20. „	N. 67° W.
8. „	N. 5° W.	21, 22. „	N. 60° W.
9. „	E. & W.	23, 24. „	N. 40° W.

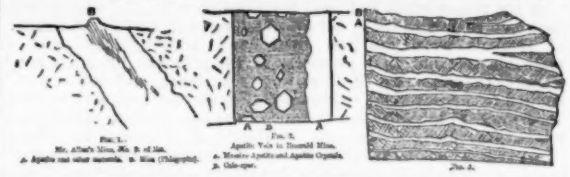
THE VEINSTUFF.—The apatite occurs in the veins generally in a massive crystalline form, green, blue, or brown, and sometimes glassy, or granular. It also occurs as large independent crystals shooting from the side of the vein. Sometimes, as in the Emerald Mine, the crystals are large, perfect at both ends, and completely enveloped in calcspar. It contains, according to Mr. Hoffman's analysis, tribasic phosphate of lime, 85·241 (the lower percentage, 74·241 of his analysis, No. 7, seems to be taken from an impure sample, and to be an exception to the rest of his results) to 89·810; fluoride of calcium, 5·860 to 7·929, besides other constituents, for which reference may be made to the Report of the Geological Survey of Canada, 1877-8, p. 10 B. In comparison with European apatites it stands thus:—

Tribasic Phosphate of Lime,	Arendal, Norway	92·189
„ „ „	Greiner, Tyrol	92·160
„ „ „	Murcia, Spain	92·066
„ „ „	Tokovaia, Ural	91·668
„ „ „	Stüdianka, Russia	91·646
„ „ „	Ottawa, mean of 7 analyses	87·521
„ „ „	Estremadura, Spain, mean of two analyses	81·593
„ „ „	Staffel, Nassau	75·273

It is, therefore, a high-class and valuable mineral, and, in my opinion, is one of the most important of the mineral resources of Canada. The calcspar is coarsely granular, white or flesh-coloured, and intimately associated with the apatite, sometimes completely surrounding the crystals, and at others forming alternate layers. In some cases, as in the specimen on the table, it has a stalagmitic surface, and in others has been deposited along with quartz and other minerals in drusy cavities. The mica, of the phlogopite species, and dark in colour, is also intimately associated with the apatite, sometimes being in large masses in the centre of the vein, or in others lining the sides of the vein, or coating the crystals of apatite. Among other minerals which I observed in the veinstuff were pyroxene, zinc blende, and pyrite both in cubes and in octohedra. For further details as to the minerals associated with apatite, reference may be made to Dr. Harrington's admirable essay.

THE ROCKS TRAVERSED BY THE VEINS.—The rock (pyroxenite of Hunt=Hypersthenite of Dana) traversed by the veins which I examined consists of a bright crystalline and massive schist, composed, to a large extent, of pyroxene (augite), more or less altered, mica, orthoclase, triclinic felspar, and apatite. It contains, according to Dr. Harrington, subordinate layers of quartz. Were it not that it is bedded it would pass muster as an eruptive rock. Looking, however, at that fact, and the further consideration that it is associated with quartzites and altered limestones, it is, in my opinion, an altered rock belonging to the Archaian (Laurentian) series, which ranges over the vast region north of the lakes and of the St. Lawrence river, and which, according to Sir W. Dawson, is not less than 30,000 ft. in thickness. In classification it goes with the Laurentian hornblendic gneisses. According to Dr. Harrington, both limestones and quartzites are traversed by veins of apatite in the North Ottawa phosphate region at Templeton, which I had no time to visit.

HISTORY OF THE VEINS.—In dealing with the very much debated question as to the history of the apatite veins, the following points seem to me the most important:—(*a*) The veins are, in some cases, sharply defined, and have evidently been deposited in a series of irregular fissures striking across the rock in various directions. (See Figs. 1 and 2.) Sometimes the veinstuff shades off into the pyroxenite—as it might reasonably be expected to shade off on the hypothesis that the deposit took place under conditions of enormous heat, and enormous pressure in the presence of water. These conditions are proved to have existed from the profound alteration of the associated Archaian rocks from the fragmental to the crystalline state. (*b*) The character of the veinstuff is such as is usually found in fissure veins. In Fig. 3 (representing veinstuff from No. 3 Portland) it pre-



sents a banded structure, formed by alternate layers of apatite (A) and pyroxene (B). In other cases layers of apatite and of a stalagmitic calcite alternate, and in one specimen on the table an angular fragment of quartzite is enveloped in veinstuff composed of mica, pyroxene, and apatite. These two characters are found together, so far as I know, only in true fissure veins, and are well known to practical workers in mineral veins generally.—(*c*). The apatite occurs disseminated through the pyroxenite rock in minute granules, and it is, therefore, argued that it has found its way into the veins by a mere progress of segregation. It seems to me more probable that both rocks and veins have received their charge from some common deep-seated source by hydrothermal action, while both were sunk deep beneath the surface, and the heat and pressure were sufficient to allow of apatite and the other minerals in the veins being deposited by water.—(*d*). The surfaces of some of the crystals of apatite present traces of hydrothermal action in their rounded angles and honeycombed surfaces, as in the specimens on the table. Solution might very well go in one place while deposition was going on in another. The presence, too, of perfect crystals of apatite completely embedded in calcspar, as in Fig. 2, can only be accounted for on the hypothesis that the vein was filled with a pasty mixture of apatite and calcite, which allowed of the former developing a perfect crystalline form, the calcspar matrix being sufficiently compact to keep the growing crystal from sinking to the bottom of the fissure. Had the fissure been empty the apatite crystals in this case, as in most others, would have been imperfect, and would spring from the side of the vein. This pasty condition of the veinstuff is only explicable, in my belief, by hydrothermal or aqueo-igneous action.—(*e*). Nor are we without proof that the veinstuff itself has been in a state of movement while it was in a pasty state in the crumpling and distortion to which the crystals of mica have been subjected. The specimens on the table have been obviously distorted by the movement of the surrounding matrix after their development as crystals.

From these facts it may be concluded that the veins of apatite in this district were formed in fissures in the Archaian rocks by hydrothermal or aqueo-igneous action under conditions of heat and pressure of the same general sort as that by which the rocks themselves have been affected, and by which the sandstones have been converted into quartzites, the mud and sandy clays into schists and crystalline rocks, and the limestones into crystalline calcite associated with serpentine. These impressions of a hasty visit to the districts in question are laid before the society not merely because they relate to a large and rapidly developing mining industry in Canada—the export last year being 14,478 tons, and the estimate for this being 23,000 tons—but because they are of local interest, since the products are largely used in Lancashire.

The following note relating to the physical characters of this important mineral, and the localities where it occurs in the British Isles, is added for the information of those who may seek for it:—

"Apatite, crystalline phosphate of lime. Hexagonal, often hemihedral, occurs in six-sided prisms terminated by one or more planes, or the prism is terminated by a six-sided pyramid, and the lateral edges are sometimes replaced. Colours usually pale, and most commonly white, yellowish white, wine yellow, green, blue, or blueish green, and red, which are sometimes intermixed in the same crystal. Externally it is splendent; internally the lustre is shining and resinous, approaching to vitreous. Transparent to opaque: Brittle, cross fractures uneven, approaching to small conchoidal. Hardness, 5. Specific gravity, 3·25.

BLOW-PIPE.—Fusible with difficulty on the edges; with borax forms a clear globule, and in salt of phosphorus dissolves in great quantity, affording a transparent glass, which when nearly saturated becomes opaque on cooling, and presents crystalline faces."

LOCALITIES.—English: Cornwall, of a greyish-blue, at Stenna Gwynn, near St. Austell; St. Michael's Mount; Huel Kind, near St. Agnes; Fowey Consols and Huel France, near Tavistock. Cumberland, at the foot of Brandygill, Carrock Fells. Devonshire, at Bovey Tracey, in crystals sometimes 2 in. long, associated with black tourmaline.—Scotch: Dee Side, in Aberdeenshire.—Irish: Near Kilroot, county Antrim, in granite; near Hilltown, Dublin; and at Killiney Hill, in limestone."—"Bristow's Glossary of Mineralogy." It has not as yet been discovered in paying quantities in the British Isles.

In the discussion which followed, Mr. STIRRUP stated that there were in England phosphatic deposits; but so far as he knew none at all like those described by Prof. Dawkins. Deposits of phosphate of lime in this country were found in the greensands and tertiaries, but were not of the extraordinary richness of those of Canada. The latter were, in Prof. Dawkins's opinion, formed by hydrothermal action; but he (Mr. Stirrup) believed they must have been produced in other ways also, because there was a deposit worked in France, and which was formed in the tertiary rocks, he believed—or at all events in some recent rocks—and in connection with fossils of cocene or even more recent type.

Prof. DAWKINS explained that the deposit Mr. Stirrup was speaking of was phosphorite, not apatite. It was a deposit of lime; the apatite contains a percentage of fluor-spar.

Mr. STIRRUP, continuing, said that in Mr. Jannetay's book on rocks the substance was called apatite. He was aware that it did not possess so high a percentage of phosphate as the Canadian phosphate. He did not believe in the theory of hydrothermal action, and thought that a more intelligible explanation was that these phosphates of lime had been derived from the rocks themselves, or from the bones of extinct animals, or even those of recent date. The impression conveyed to the mind of Mr. De Rance by the paper was that Prof. Dawkins thought that the phosphate of lime was derived from the interior of the earth through fissures in the earth's crust.

Prof. DAWKINS, in reply to the Chairman, explained that in the district he visited the rocks in which the veins are found consist of pyroxene; but in other districts where there are apatite mines they consist of quartzite and limestone. The veins occur as much in the limestone as in the older rocks. With regard to the commercial question, the output of the Emerald Mine when he was at Buckingham was valued at $18 or $19 per ton; the actual cost of getting, $5 or $6. So far as he knew apatite occurred invariably in highly altered and crystalline rocks. Minute apatite crystals were quite a common constituent in many of the igneous rocks, but never under conditions such as were observed in Canada—that was in veins. Wherever apatite veins had been met with in Russia, Spain, Germany, and especially in Norway, it was invariably in the highly altered rocks. He could not see his way to accepting the view that these veins had been filled with material derived from the surrounding rocks, because they did not possess such a material as apatite—a combination of phosphate of lime with fluoride of calcium. The sand banks and the sandy mud banks forming the schists did not possess it, and still less was it an original constituent of the limestones. It seemed, therefore, quite reasonable to suppose that the crystals of apatite were introduced into the rocks in the same way as they were introduced into the mineral veins. If so, he should like to know where they came from, if not from below? There was not the slightest reason for supposing that they came from above; and he, for one, when he found veins traversing rocks of widely different constitution was driven to suppose that they derived their existence from a source independent of all. The question as to the occurrence of crystals of apatite was an entirely different one from that of the ordinary phosphorite. He could not explain the presence of perfect crystals of apatite in a matrix of calcspar unless the calcspar somehow or other prevented those crystals from descending to the bottom of the fissure or being perched on the sides of it. He did not know how such a process could have gone on unless the contents of the fissure were in a pasty condition, due to the veins and rocks being at an enormous depth below the surface and subjected to hydrothermal action—an action which has left its mark on all the oldest rocks and especially on the archaian rocks. Rocks of that character were sparsely distributed in this country. They were to be found in the west of Cornwall, in Anglesey and Wales, and in the Highlands of Scotland—also in the Hebrides, but he did not anticipate any important phosphate deposits would be found in any of the older rocks in this country. It must be remembered that, even in the United States and Canada, these deposits were exceedingly local. The area covered by the archaian rocks, in those regions, was a vast area, and the apatite deposits were scattered over it, occupying only an area relatively small. Crystals of apatite had been found in some of the iron mines of the United States, in ordinary veins. Whatever might be the source of apatite it seemed to him that it was to be looked upon as a mineral filling a vein exactly as the lead, silver, or gold in a metalliferous mine.

HOLLOWAY'S PILLS AND OINTMENT.—GLAD TIDINGS.—Some constitutions have a tendency to rheumatism, and are, throughout the year, borne down by its protracted tortures. Let such sufferers bathe the affected parts with warm brine, and afterwards rub in this soothing ointment. They will find it the best means of lessening their agony, and, assisted by Holloway's pills, the surest way of overcoming their disease. More need not be said than to request a few days' trial of this safe and soothing treatment, by which the disease will ultimately be completely swept away. Pains that would make a giant shudder are assuaged without difficulty by Holloway's easy and inexpensive remedies, which comfort by moderating the throbbing vessels and calming the excited nerves.

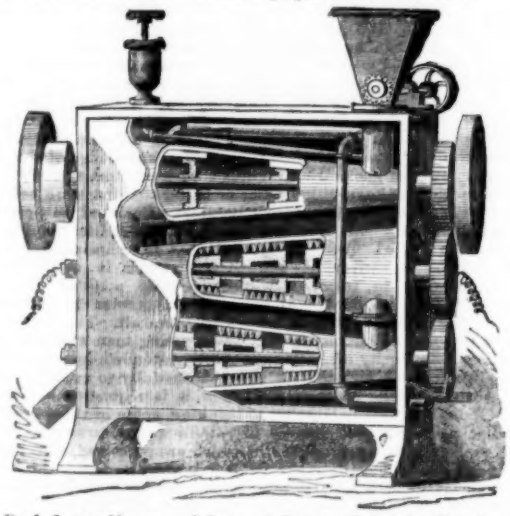
RAILS — STEEL AND IRON.—NEW, PERFECT, and SLIGHTLY DEFECTIVE. Suitable for Colliery Sidings and Contractors' purposes. Large and assorted stocks.—Apply for Sheet of Sections to

BOLLING AND LOWE,
2, LAURENCE POUNTNEY HILL, LONDON, E.C.

NOVEL ELECTRO METALLURGICAL MACHINE.

PROFESSOR JAMES MANES AND SONS call the attention of miners, mineowners, capitalists, and others interested in the working of gold or silver mines to their new Electro Metallurgical Machine for extracting fine and rusty gold from sands or tailings of stamp mills, or the sands of hydraulic gold diggings, or from the black sands on the coast of Oregon or California, and other parts of the world where gold is found.

The problem that has long troubled the worker of free-milling gold and silver ores is a method to save the mineral now lost in the tailings of stamp mills or flumes. This alone, if it could be saved, would amount to many million dollars profit each year, besides enabling the working of much territory which is now lying idle for want of an economical and thorough process of treatment.



Prof. James Manes and Sons, of Denver, Colorado, U.S., have invented a machine (represented in the above engraving) which it is claimed will save nearly the entire amount of mineral which passes through it, the loss not being over 10 per cent., and in many cases not in excess of half that amount. The machine is a cheap and practical process—it never need stop for charging or cleaning up, being nearly self-acting. Steam, electricity, and mercury are used in the process of extracting the mineral.

This machine or amalgamator is adapted for free-milling gold or silver ores, or refractory after roasting. It consists of a series of three or more large cylinders, wider at one end than the other, placed one above the other in a horizontal position, a shaft or spindle running through the centre of each.

The ore and mercury are fed into the first cylinder, passing into the second, and then to the third. The first cylinder is furnished with steel mullers which nearly touch the sides of the cylinder, and revolve at a good rate of speed, mixing the mercury and ore. The second cylinder is furnished with large steel brushes attached to the shaft or spindle, revolving at a high rate of speed; through this a current of electricity is furnished by a Westinghouse dynamic electro machine, which materially assists in gathering the particles of very fine gold together, and thoroughly amalgamating the metal and mercury. The third cylinder is similarly furnished to the second; into this the amalgam passes, and is again acted upon and mixed by the brushes to catch any gold which might have escaped amalgamation in the second. A fourth cylinder may be used if found necessary.

The amalgamated pulp then passes through a revolving copper drum, plated with quicksilver inside. As the drum revolves it takes up the most part of the amalgamated gold. As the inside of the drum is constantly washed with a spray of water from perforated pipes fixed inside of said drum, a clean-plated surface is constantly brought in contact with the pulp or tailings as it passes out from the cylinders. After leaving the drum it falls down on to incline copper plates, the same as is now used in stamp mills.

The amalgam can be collected from the drum and plates without stopping the machine, and any live quicksilver that passes will be caught in syphons. The tailings are carried off with the water. The machine when attached to the flume will be driven by the waste water; it sifts the fine sands from the coarse gravel, and amalgamates it as above.

The specific points claimed by Prof. Manes and Sons in their patent are—

1.—The saving of almost all the mineral passing through the machine.

2.—The loss being less than 10 per cent.

3.—The entire absence of loss of the amalgamated material, thereby saving all the mercury, which, with the processes now in use, there is a large loss both of mercury and the precious metal.

4.—The small cost per ton at which the ore can be treated.

By the addition of the powerful current of electricity that passes off the revolving brushes, the most minute particles of gold will be caught and retained, which in the ordinary flume and stamps passes off with the water; this often amounts to a large percentage.

The inventors state that if English stock companies will give their assistance to work the black sands of Oregon and California by paying for the building of the machines, they will take a share of the gold for their services, or they will send their machines to any part of the world, or will sell patent rights to those desiring any of their patent machines or revolving furnaces for roasting or smelting ores, ball pulverisers, &c.

Prof. James Manes and Sons are agents for the Morey and Sparey Ball Pulveriser, that crushes and pulverises at the same time, and does as much work as eight stamps in a day, crushing either wet or dry.

PRINCIPAL OFFICE OF
Prof. MANES and SONS,
No. 372, Glanarm Street, Denver, Colorado,
U.S.A.

All our machines and furnaces are made by the Colorado Iron Company of Denver, Colorado, the most extensive mining machine works in America.

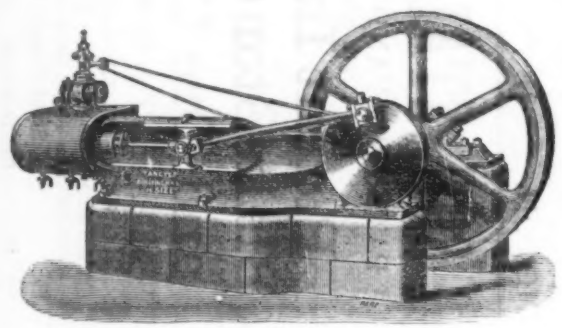
TANGYES LIMITED, CORNWALL WORKS, BIRMINGHAM.

LONDON: 35, Queen Victoria Street. **NEWCASTLE: St. Nicholas Buildings.** **MANCHESTER: Deansgate.** **GLASGOW: Argyle and Hope Streets.**

(No. 1.)

TANGYE'S HORIZONTAL STEAM ENGINE.

WITH PATENT GOVERNOR.



In this Engine the bed-plate, front cylinder cover, crosshead guides, and plummer block for crank shaft bearing, are cast in one, the cylinder with its valve chest being bolted to the end of the bed. The crosshead slippers and connecting rod ends are made adjustable, so that any wear can be readily taken up. The fly-wheel face, cylinder end, connecting rod, and crank plate are bright.

All parts to Whitworth's Gauge: duplicates can be obtained by giving number of Engine.

The speed of the Engine can be increased or reduced by simply tightening or releasing the cap which forms the top of the Governor.

A Sole Plate for Back Chair is included in price.
The Feed Pump has Gun-metal working parts.
The H, I, J, JA, K, and M sizes have Steam Jacketted Cylinders.

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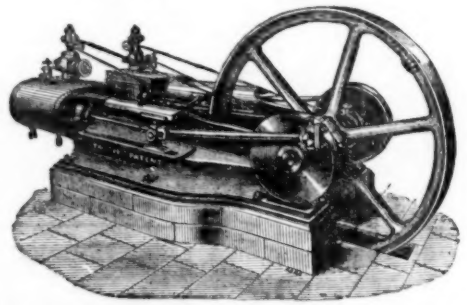
TANGYES' HORIZONTAL STEAM ENGINE,

COUPLED, WITH PATENT GOVERNOR.



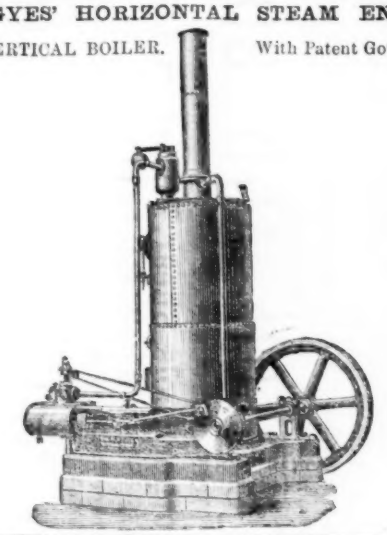
These Engines are precisely the same in design as the foregoing, and being made right and left hand can be coupled for many purposes with great advantage, forming a very handsome and compact arrangement. They are now supplied with one large Governor between the pair, together with Stop Valve to each Engine, but separate Governor, as illustrated, can be supplied at an extra price if ordered. The fly-wheel is in halves, and fitted with turned Bolts.

Size	B	C	D	E	G	H	I	J	JA	K	M
Nominal horse power	4	6	8	12	16	20	24	28	32	40	50
Diam. Steam Cyls. ..... ins.	4	5	6	8	9	10	11¼	12	13	14¼	16
Length Stroke ..... ,,	8	10	12	16	18	20	20	24	24	28	28
Revolutions per Min.	180	144	120	100	90	85	85	75	75	65	65
Price per Pair..... £	50	68	80	126	160	208	230	250	290	350	400
Feed Pumps, pair ..... extra £	6	7	8	10	12	14	14	16	16	20	30
Variable Expan. Gear ,, £	—	—	—	—	26	23	28	30	32	40	50
Holding Down Bolts & Plts. £	2	2 15	3	5	4 15	7 5	8	10	10	13	14
Diam. Fly-wheel ..... ins.	30	39	54	60	66	78	78	84	84	96	120
Width Face, turned..... ,,	3½	5	6	7	9	12	15	18	18	20	24
Diam Steam Inlet ..... ,,	1¼	1½	1¾	2	2½	3	3½	3½	4	5	5½
,, Steam Outlet (two) ,,	1¼	1½	1¾	2¼	2½	3	3½	3½	4	4½	5

6

TANGYES' HORIZONTAL STEAM ENGINE

AND VERTICAL BOILER. With Patent Governor.



Size	B	C	D	E	G	H	I	J
Nominal Horse-power	2	3	4	6	8	10	12	14
Diam. Steam Cyl. ..... ins	4	5	6	8	9	10	11¼	12
Length Stroke..... ,,	8	10	12	16	18	20	20	24
Revolutions per Min.	180	144	120	100	90	85	85	75
Engine and Boiler on Base with Feed Pump ..... £	63	80	98	130	170	215	238	270
Diam. Fly-wheel ..... ins.	30	39	48	54	60	66	66	72
Width Face, turned ..... ,,	3	4	5	6	7	8	8	9
Weight ..... cwt.	21	30	43	62	87	113	125	154

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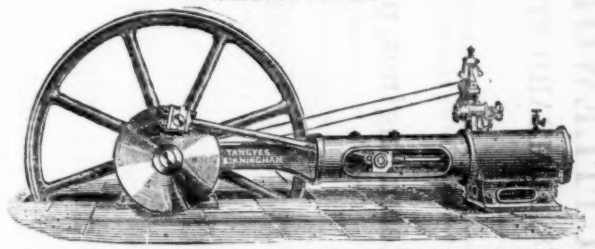
TANGYES' HIGH-PRESSURE STEAM ENGINE

With Patent Governor.



In this Engine the piston rod, valve spindle, and crank shaft are of steel, the bearings extra large, and so arranged that any wear can be readily taken up. The main bearings, of gun-metal, are in three pieces, and are fitted with wedge adjustment. The expansion valves are so arranged that they can be adjusted to any required grade of expansion whilst the Engine is in motion; the cylinder is steam jacketted, lagged with sheet steel, and fitted with relief valves, condensed steam cocks, lubricators, and grease cups. The Fly-wheel is in halves, and fitted with turned Bolts.

The speed of the Engine can be increased or reduced by simply tightening or releasing the cap which forms the top of the Governor.

Nominal Horse-power.....	30	40	50	60
Diam. Steam Cylinder ..... ins.	18	20	22¼	24½
Length Stroke ..... ,,	36	40	40	48
Revolutions per Minute	60	53	53	44
Price Engine with Varble. Expn. Gear.....£	275	350	400	490
Holding-down Bolts and Plates .....extra £	14	15	16	17
Diam. Fly-wheel ..... ins.	132	144	168	180
Width Face, turned ..... ,,	12	22	24	26
Diam. Fly-wheel Shaft ..... ,,	6¾	7½	7¾	8½
Length ,, ,, ... ,,	81	87	93	102
Diam. Steam Inlet ..... ,,	4½	5	5½	6
,, Exhaust Outlet..... ,,	6	7	8	9
Weight Engine and Fly-wheel .....tons	9	13	14½	21½
,, Fly-wheel only ..... ,,	2¾	5	6	8

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TANGYE'S HORIZONTAL STEAM ENGINE.

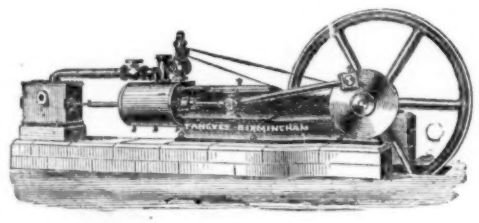
Size	B	C	D	E	G	H
Nominal Horse-power	2	3	4	6	8	10
Diam. Steam Cylinder ..... ins.	4	5	6	8	9	10
Length Stroke ..... ,,	8	10	12	16	18	20
Revolutions per Minute.....	180	144	120	100	90	85
Price of Engine..... £	25	34	40	53	80	104
Feed pump ..... extra £	3	3 10	4	5	6	7
Variable Expansion Gear ..... ,, £	—	—	—	—	13	14
Holding-down Bolts and Plates ,, £	1 5	1 15	2	3	4 10	5
Diam. Fly-wheel ..... ins.	30	39	48	54	60	66
Width Face, turned..... ,,	3	4	5	6	7	8
Diam. Fly-wheel Shaft ..... ,,	2	2½	2¾	3¼	3½	4
Length ,, ,, ... ,,	28	36	39	45	48	51
Diam. Steam Inlet ..... ,,	⅜	1	1⅛	1⅛	1⅜	2
,, Exhaust Outlet ..... ,,	1¼	1½	1⅜	2¼	2½	3
,, Suc. and Dely. Feed Pump... ,,	½	¾	1	1¼	1¼	1½
Weight Engine..... cwts.	4½	7	9¼	17	27½	35½
,, Fly-wheel ..... ,,	1¾	3¼	6¾	9½	13	16

Size	—	I	J	JA	K	M
Nominal Horse-power	—	12	14	16	20	25
Diam. Steam Cylinder ..... ins.	—	11¼	12	13	14¼	16
Length Stroke ..... ,,	—	20	24	24	28	28
Revolutions per Minute.....	—	85	75	75	65	65
Price of Engine..... £	—	115	125	145	175	200
Feed Pump..... extra £	—	7	8	8	10	15
Variable Expansion Gear ..... ,, £	—	14	15	16	20	25
Holding-down Bolts and Plates ,, £	—	6	6	6	7 10	8
Diam. Fly-wheel ..... ins.	—	66	72	72	90	108
Width Face, turned..... ,,	—	8	9	9	10	12
Diam. Fly-wheel Shaft ..... ,,	—	4¾	4⅞	4⅞	4⅞	5⅜
Length ,, ,, ... ,,	—	54	54	54	63	72
Diam. Steam Inlet ..... ,,	—	2½	2½	3	3½	4
,, Exhaust Outlet ..... ,,	—	3⅜	3½	4	4½	5
,, Suc. and Dely. Feed Pump... ,,	—	1½	1⅝	1⅝	1¾	1¾
Weight Engine..... cwts.	—	36	43	50	63	74
,, Fly-wheel..... ,,	—	16	22	23	30	40

5

TANGYES' HORIZONTAL CONDENSING STEAM ENGINE,

WITH PATENT GOVERNOR.



The illustration shows the "Tangye" Steam Engine, combined with Horizontal Air Pump Condenser. The Condenser is fitted with a three-way Valve, to allow exhaust steam to be easily diverted into atmosphere, and for facilitating starting.

The speed of the engine can be increased or reduced by simply tightening or releasing the cap which forms the top of the Governor.

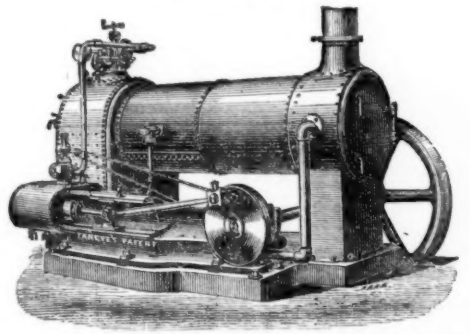
Size	D	E	G	H	I	J	JA	K	M
Nominal Horse power	4	6	8	10	12	14	16	20	25
Diam. Steam Cylinder ... ins.	6	8	9	10	11¼	12	13	14¼	16
Length Stroke ..... ,,	12	16	18	20	20	24	24	28	28
Revolutions per minute... ,,	120	100	90	85	85	75	75	65	65
Price of Engine with condenser and connections £	73	102	123	150	163	180	206	244	276
Variable Expan. Gear, extra £	—	—	13	14	14	15	16	20	25
Hold. down Bolts & Plts. ,, £	2 10	3 10	5 10	6	7	8	8	9	10
Diam. Fly-wheel ..... ins.	48	54	60	66	66	72	72	90	108
Width Face, turned..... ,,	5	6	7	8	8	9	8	10	12
Diam. Steam Inlet ..... ,,	1½	1½	1¾	2	2½	2½	3	3½	4
,, Exhaust Outlet ..... ,,	1¼	2¼	2½	3	3½	3½	4	4½	5

7

TANGYES' HORIZONTAL STEAM ENGINE

AND MULTITUBULAR BOILER.

With Patent Governor.



This illustration shows a combination of the "Tangye" Steam Engine, and Multitubular Boiler, mounted on a strong cast iron base.

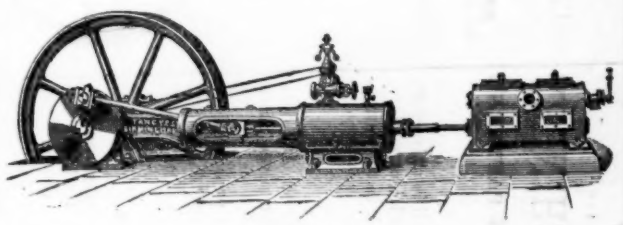
Feed Pump included in price.

Size	D	E	G	H	I	J
Nominal Horse-power of Engine	4	6	8	10	12	14
,, ,, Boiler.....	6	8	10	12	14	16
Diam. Steam Cylinder ..... ins	6	8	9	10	11¼	12
Length Stroke ..... ,,	12	16	18	20	20	24
Revolutions per Minute.....	120	100	90	85	85	75
Price..... £	132	170	204	240	275	314
Variable Expansion Gear .... extra £	—	—	13	14	14	15
Link Motion Reversing Gear ..... £	20	20	20	22	22	23
Diam Fly-wheel ..... ins.	48	54	60	66	66	72
Width Face, turned..... ,,	5	6	7	8	8	9
Weight ..... cwts.	70	90	120	150	170	195

9

TANGYES' HIGH-PRESSURE CONDENSING STEAM ENGINE,

WITH PATENT GOVERNOR.



This Engine is that described as "Tangyes' High-pressure Steam Engine," with Horizontal Air Pump Condenser attached.

The Air Pump is double acting, and so arranged with the Condenser that the piston always works in water free from air spaces for vapour to expand in.

Nominal Horse-power	30	40	50	60
Diam. Steam Cylinder..... ins.	18	20	22¼	24½
Length Stroke..... ,,	36	40	40	48
Revolutions per Minute	60	53	53	44
Price Engine and Condenser..... £	355	450	505	605
Holding-down Bolts and Plates ... extra £	18	20	21	23
Diam. Fly-wheel..... ins.	132	144	168	180
Width Face, turned ..... ,,	12	22	24	26
Diam. Fly-wheel Shaft ..... ,,	6¾	7½	7¾	8½
Length ,, ,, ... ,,	81	87	93	102
,, Steam Inlet ..... ,,	4½	5	5½	6
,, Exhaust..... ,,	6	7	8	9

11

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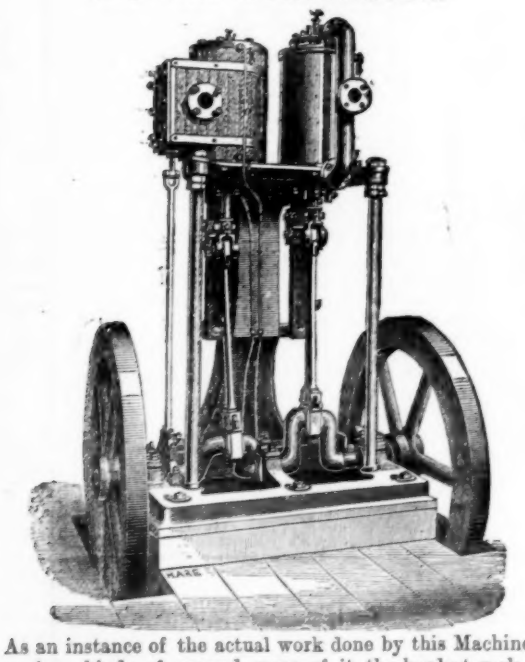

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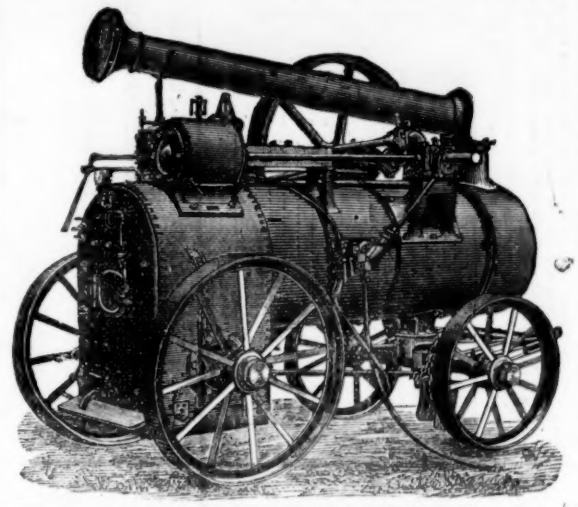

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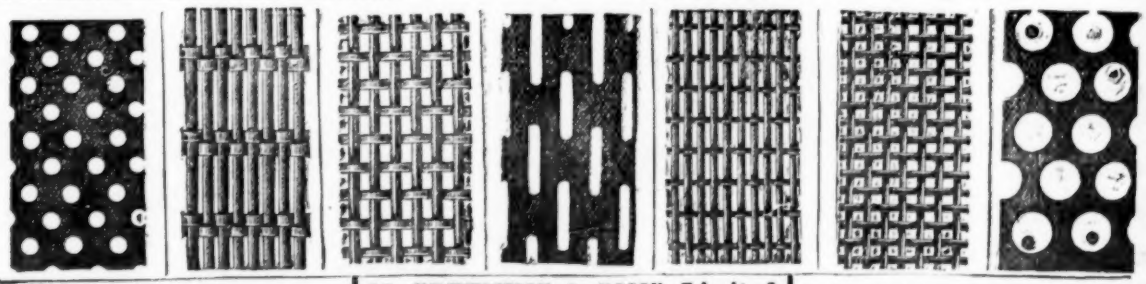

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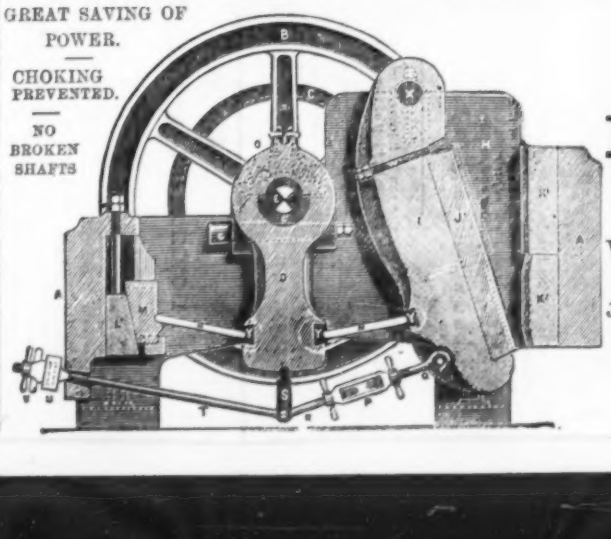

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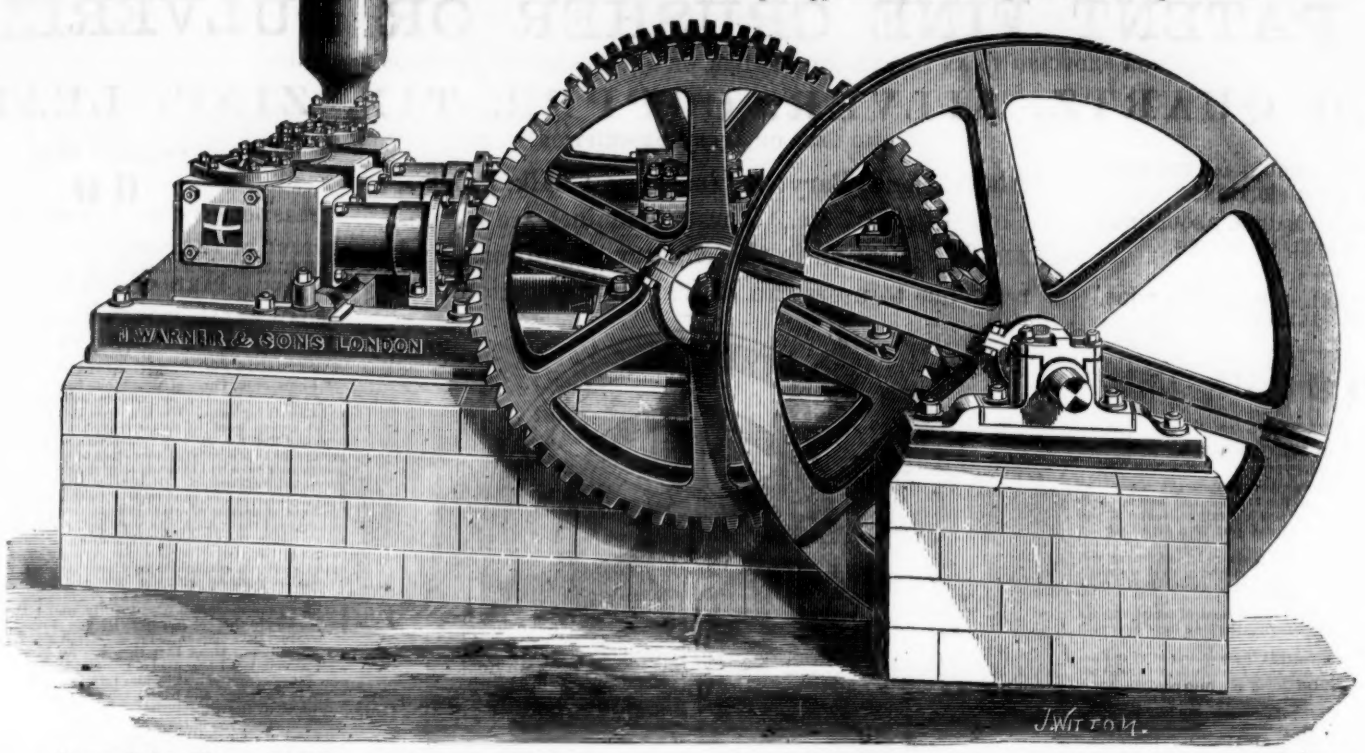

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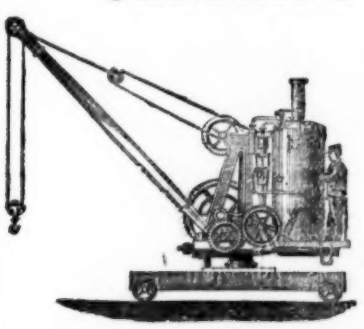

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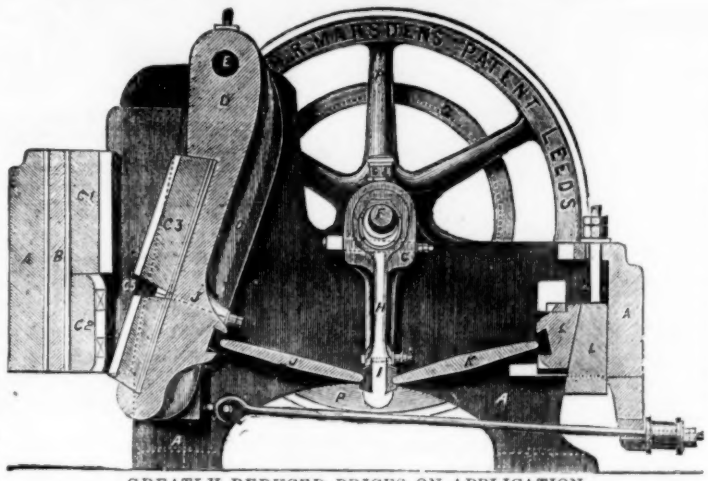

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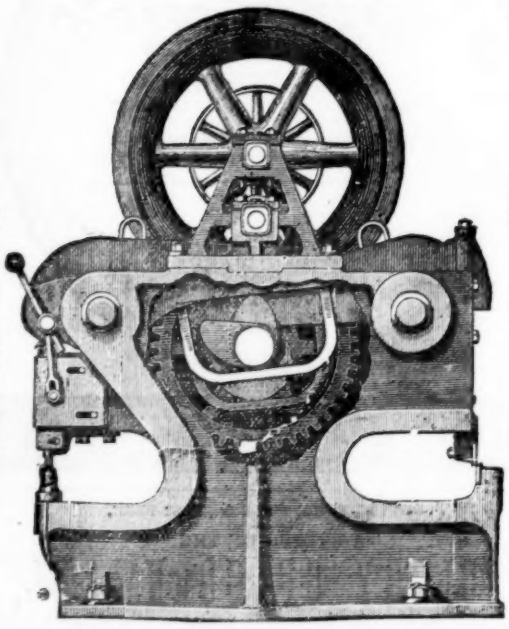

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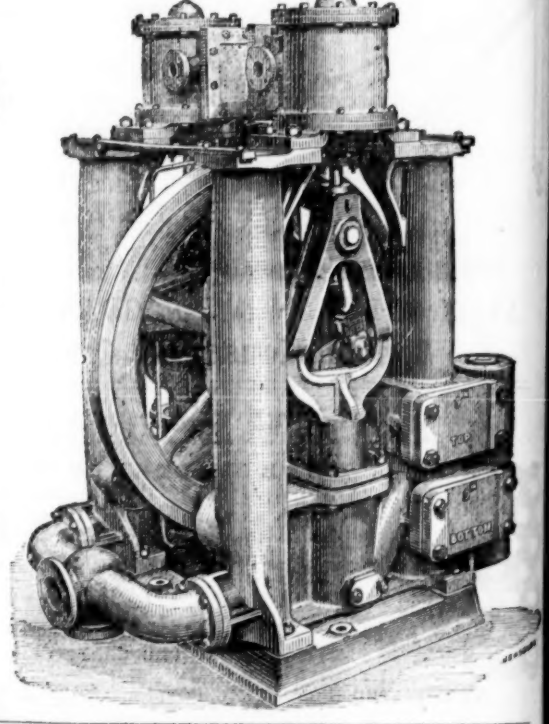

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